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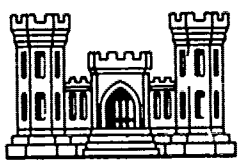
LAKE SAINTE LOUISE DAM
ST. CHARLES COUNTY, MISSOURI
MO 10490

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



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Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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SUBJECT: Lake Sainte Louise Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Lake Sainte Louise Dam.

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

1) Spillway will not pass 50 percent of the Probable Maximum Flood.
2) Overtopping could result in dam failure.
3) Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED
Chief, Engineering Division
25 SEP 1978
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer
25 SEP 1978
Date

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LAKE SAINTE LOUISE DAM
ST. CHARLES COUNTY, MISSOURI

MISSOURI INVENTORY NO. 10490

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY:

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U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
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SEPTEMBER 1978

HS-7848

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Lake Sainte Louise Dam
State Located:	Missouri
County Located:	St. Charles
Stream:	Tributary of Peruque Creek at Lake Saint Louis
Date of Inspection:	19 June 1978

The Lake Sainte Louise Dam was visually inspected by engineering personnel of the office of Horner & Shifrin, Inc., Consulting Engineers, St. Louis, Missouri. The purpose of the inspection was to assess the general condition of the dam with respect to safety and, based upon this inspection and available data, determine if the dam poses a hazard to human life or property.

Based on a visual inspection, the present general condition of the dam is considered to be satisfactory. The following deficiencies were noticed during the inspection and are considered to have an adverse effect on the overall safety and future operation of the dam.

a. Several inches of subsidence or erosion of the downstream slope of the dam, along the alignment of the 12-inch discharge pipe for the 42-inch diameter drop inlet spillway located near the center of the dam, was observed. It could not be determined at the time of the inspection if this loss of material was due to pipe infiltration, or erosion caused by storm water runoff, or settlement of pipe backfill, or a combination thereof. If embankment materials are being lost through this pipe, the result may be rapidly increasing internal erosion which could cause a piping failure of the dam. The kind and type of pipe and pipe joints used for the 12-inch pipe should be determined and reviewed to verify their suitability for this installation. As presently used, the 12-inch pipe is subjected to the pressure produced by the lake water surface level on a permanent basis.

b. Minor wearing away at the waterline of the upstream face of the dam was noticed. The condition is not considered serious at this time but continued erosion of this slope will reduce the dam cross section.

c. At the time of the inspection, it could not be determined if the 10-inch sanitary sewer passing beneath the dam can be isolated if necessary in order to prevent loss of foundation soils, should collapse of the sewer beneath the dam occur. Voids resulting from loss of materials into the sewer will provide a passageway for seepage that may develop into a piping condition and subsequent failure of the dam.

Modifications by the owner to the outlet pipe of the 42-inch drop inlet spillway located near the center of the dam for installation of a lake replenishment pump have negated the use of the pipe as a spillway. These changes include plugging the existing 12-inch pipe outlet with concrete such that it no longer functions as an outlet, and installation of a 10-inch valve and pipe to connect the existing 12-inch outlet pipe to a pump discharge line. The valve is normally maintained closed in order to prevent backflow and loss of water from the lake. When the pump is installed (it was not at the time of the inspection) and operated, the valve is opened and flow is introduced into the lake through the 42-inch vertical riser. At the time of the inspection the valve was closed, although it was leaking at the rate of several gallons per minute.

According to the criteria set forth in the recommended guidelines (see text) the minimum spillway design flood for this dam, which is classified as intermediate in size and of high hazard potential, is specified to be the Probable Maximum Flood (PMF). PMF is the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. Results of a hydrologic/hydraulic analysis indicated the existing spillways (drop inlet plus emergency) to be inadequate to pass lake outflow resulting from a storm of PMF magnitude without overtopping the dam; however, they are adequate to pass lake outflow

resulting from the 1 percent chance (100-year frequency) flood. The existing spillways (drop inlet plus emergency) are capable of passing lake outflow corresponding to 22 percent of the PMF. The length of the downstream damage zone, should failure of the dam occur, is estimated to be 11 miles.

It was found by hydraulic analysis that the combined capacity of the two drop inlet spillways, without allowing the lake water level to exceed elevation 547.3 (the crest of the emergency spillway) is about 90 cfs. With lake level to elevation 548.3, the maximum water surface elevation without overtopping the dam, the emergency spillway will permit an overflow of about 547 cfs and the combined capacity of the two drop inlet spillways will increase to about 93 cfs, thus providing a total capacity of 640 cfs. In the investigations for spillway capacity, it was assumed that the 42-inch drop inlet spillway will function as originally intended.

It is believed that the liquid petroleum tanks located on the area adjacent to the downstream toe of slope of the dam presents a hazardous condition should failure of the dam occur. In addition to damages due to the flood wave if the dam fails, the leakage of liquid petroleum will create a possible explosion hazard.

Also present on the downstream area immediately adjacent to the dam is an electric substation. Failure of the dam would undoubtedly damage or destroy this installation. Explosions caused by sparks igniting leaking LP gas may cause damages above the level of the floodwaters.

A review of available data did not disclose that seepage and stability analyses of the dam were performed. This is considered a deficiency and should be rectified.

It is recommended that the owner take the necessary action in the near future to correct or control the deficiencies and safety defects reported herein.

Albert B. Becker, Jr.

Albert B. Becker, Jr.
P.E. Missouri E-9168

OVERVIEW OF LAKE AND DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
LAKE SAINTE LOUISE - ID NO. 10490

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
LAKE SAINTE LOUISE - ID NO. 10490

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. National Dam Inspection Act, Public Law 92-367, dated 8 August 1972.

b. Purpose of Inspection. The purpose of this visual inspection was to make an assessment of the general condition of the dam with respect to safety and, based upon available data and this inspection, determine if the dam and spillway pose a hazard to human life or property.

c. Evaluation Criteria. This evaluation was performed in accordance with the "Phase I" investigation procedures as prescribed in "Recommended Guidelines for Safety Inspection of Dams," Appendix D to "Report of the Chief of Engineers on the National Program of Dams," dated May 1975.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances. The Lake Sainte Louise Dam is an earthfill type embankment rising approximately 50 feet above the original stream bed. Lake level is governed by overflow of two drop inlet type spillways with outlets leading to Lake Saint Louis. A paved road, Savoy Drive, traverses the dam crest. The low roadway area east of the right (looking downstream) abutment will function as an emergency spillway should the lake level rise above the roadway at this location. The capacity of this area to serve as a spillway is limited to flow with a depth of about 12-inches before discharge will overflow the dam. A general plan of the dam and appurtenances is shown on Plate 2.

The 12-inch outlet pipe for the 42-inch diameter drop inlet spillway (see Photo 7) located near the center of the dam has been modified to accommodate a pump for replenishing lost water in Lake Sainte Louise by pumping from Lake Saint Louis. These changes include plugging the existing 12-inch pipe outlet with concrete and installation of a 10-inch valve and pipe to connect the 12-inch pipe to a pump. In addition, the operating stem for controlling the valve on the high level lake drawdown pipe, allowing water to flow into the 42-inch spillway, has been disconnected and the valve allowed to remain open. The other spillway, a 48-inch by 102-inch drop inlet (see Photo 3) with a 36-inch outlet pipe is located at the right (looking downstream) abutment of the dam. The overflow level of both drop inlet type spillways is approximately the same. The 36-inch pipe terminates at an open, 4-foot square, manhole (see Photo 4) located approximately 290 feet from the inlet in an area east of the right abutment. At this structure discharge is required to overflow the top of the manhole or continue in a 15-inch pipe for another 28 feet, depending upon the volume of flow. After leaving the manhole, flow continues toward Lake Saint Louis in an unimproved ditch. An electric substation and a liquid petroleum tank farm (see Photos 12 and 13) occupy a portion of the area immediately downstream from the dam.

b. Location. The dam and lake are located on an unnamed tributary of Peruque Creek approximately 6 miles west of O'Fallon, Missouri, in St. Charles County, as shown on the Regional Vicinity Map on Plate 1. The dam is located in U. S. Survey 929, Township 47 North, Range 2 East, on the west side of Lake Saint Louis which is just south of the Interstate 70 crossing of Peruque Creek.

c. Size Classification. The size classification based on the height of the dam and storage capacity is categorized as intermermediate. (Per Table 1, Recommended Guidelines for Safety Inspection of Dams.)

d. Hazard Classification. According to the St. Louis District, Corps of Engineers, the Lake Sainte Louise Dam has a high hazard potential, meaning

that the dam is located where failure may cause loss of life, serious damage to homes, extensive agricultural, industrial and commercial facilities, important public utilities, main highways, or railroads. According to the St. Louis District, the estimated damage zone, should failure of the dam occur, extends 11 miles downstream of the dam. The damage zone includes Lake Saint Louis Dam, which would likely fail if Lake Sainte Louise Dam fails. Within the possible damage zone of the two dams are 36 homes, 11 of which could be damaged by backflooding, and 8 bridges, 4 of which are major bridges, including Interstate Highway 70 and 3 additional highways. The floodplain downstream of Lake Saint Louis Dam is extensively farmed. In addition, a liquid petroleum (LP) tank farm with approximately 60 LP tanks and an electric substation are located on the area immediately below the dam and, in all likelihood, would be severely damaged if failure of the dam occurred.

e. Ownership. The dam is owned by the Lake Saint Louis Community Association, 20 Ellerman Road, Lake Saint Louis, Missouri, 63367. The association presently consists of 2,443 home and/or property owners.

f. Purpose of Dam. The dam impounds water for the purpose of recreation for surrounding residential property owners, who are part of the Lake Saint Louis Community Association.

g. Design and Construction History. A hydrologic study of the proposed dam and lake was made about 1965 by the firm of R. W. Booker & Associates, Inc., Consulting Engineers, St. Louis, Missouri, for the potential developers of the Lake Saint Louis subdivision property. This report recommended that the design of the dam and spillway be predicated on the probable maximum flood. The design of the dam and spillway was prepared during 1966 by Bernard G. Browning, P. E., Fulton, Missouri, for the Lake Saint Louis Investment Corporation, the site developer.

h. Normal Operational Procedure. The lake level is normally regulated by overflow of the 48-inch by 102-inch drop inlet type spillway structure located near the right abutment of the dam. If conditions warrant the 42-inch

drop inlet spillway can also be utilized to relieve lake surcharge. However, the 10-inch valve controlling this spillway outlet is normally closed and must be opened manually for the drop inlet to function as a spillway. During periods of low lake level a pump is installed to replenish lost lake water by pumping from Lake Saint Louis to Lake Sainte Louise. The original outlet pipe for the 42-inch spillway is utilized as a pump discharge line. According to the owner, the capacity of the pump is estimated to be 1,500 gpm.

1.3 PERTINENT DATA

a. Drainage Area. The areas triburary to the lake are primarily suburban residental and agricultural in use. The watershed above the dam is approximately 2.1 miles long and the width varies to a maximum of about 0.7 of a mile. The total area is approximately 664 acres. The watershed area is outlined on Plate 1.

b. Discharge at Damsite.

(1) During maximum flood experienced at damsite ... 88± cfs(1)

(2) Spillway capacity

a. Drop inlets (total) ... 90 cfs(2)

b. Drop inlets and emergency (total) ... 640 cfs(3)

c. Elevation (ft. above MSL).

(1) Top of dam ... 548.3 (min.)

(2) Normal pool (spillway crest) ... 545.3

(3) Streambed at centerline of dam ... 497.0±

(4) Maximum known tailwater (Lake Saint Louis) ... 502.0

d. Reservoir.

(1) Length of maximum pool (elevation 548.3) ... 4,900 ft.

(2) Length of normal pool (elevation 545.3) ... 4,500 ft.

(1) Computed value for water surface at elevation 547.0 and based upon high water mark indicated by a resident living adjacent to the lake.
(2) Water surface at elevation 547.3.
(3) Water surface at elevation 548.3.

e. Storage.

(1) Normal pool ... 1,170 ac. ft.

(2) Top of dam (incremental) ... 2 . ac. ft.

f. Reservoir Surface.

(1) Top of dam ... 84 acres

(2) Normal pool ... 72 acres

g. Dam. Data tabulated below per survey made on date of inspection unless otherwise indicated.

(1) Type ... Earthfill, homogeneous

(2) Length ... 790 ft.

(3) Height ... 52 ft.

(4) Top width ... 58 ft.

(5) Side Slopes

a. Upstream ... 1v on 2.5h

b. Downstream ... 1v on 2.5h

(6) Cutoff ... Core trench(1)

(7) Zoning ... None

(8) Core wall ... None

(9) Slope Protection

a. Upstream ... Grass

b. Downstream ... Grass

h. Spillways.

(1) Type ... Drop inlet

a. 42" diameter shaft with 10" pipe outlet and valve(2)

b. 48" x 102" rectangular shaft with 36" pipe outlet

(2) Lip elevation ... 545.3 (both)

(3) Upstream channel ... Lake

(1) Per report by Bernard G. Browning, 19 October 1969.
(2) Original 12-inch outlet pipe plugged with concrete and presently unusable.

i. Emergency Spillway.

(1) Type ... Paved road control section

(2) Approximate length ... 410 ft. (at elevation 548.3)

(3) Crest elevation ... 547.3 (min.)

j. Outlet for Lake Drawdown ... Partial drawdown only, estimated to be about 4 feet below normal pool, however, not operable at present time.

k. Sanitary Sewer ... Passing beneath dam near center of structure.

(1) Size ... 10-inch

(2) Type of pipe ... Unknown

(3) Invert ... Elevation 497.2 (manhole at junction of sewer lines near downstream toe of dam)

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

a. Subsurface Investigations. Available test boring logs and other data for subsurface investigations obtained by the Browning Test Laboratories, Inc., including a report prepared by the Missouri Geological Survey, are presented on Charts 2-1 thru 2-25. Borings 1 thru 7 and 11 were taken at the dam site while borings 8 thru 10 and 12 thru 14 were taken in borrow areas in the vicinity of the dam, as noted.

b. Dam. Review of the preliminary engineering report prepared by Bernard G. Browning, P.E., indicates that the dam was designed as a homogeneous earthfill type embankment with an impervious fill seepage cutoff core trench to bedrock. No additional design data was readily available.

c. Spillway. No detailed hydraulic or structural design data was found to be available. Data included in the R. W. Booker hydrologic investigation report was found to be of limited value due to differences between the recommendations included in the report and the improvements actually constructed as observed at the time of the inspection.

2.2 CONSTRUCTION

The dam was constructed during 1966 - 1967 by the developer of Lake Saint Louis. No additonal construction data was obtainable.

2.3 OPERATION

The maximum loading on the dam according to an owner living adjacent to the lake was a storm that produced a high water mark equivalent to about elevation 547.0.

2.4 EVALUATION

a. Availability. The only engineering data obtained was the material contained in the preliminary engineering report prepared by Mr. Browning. Other data is believed to exist, however, attempts to obtain this information were not successful.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the dam and appurtenances was made by Horner & Shifrin engineering personnel on 19 June 1978. The possible flood damage zone between the dam and the Highway 79 Bridge crossing Peruque Creek downstream from the dam was also visually examined. Photographs of the dam and appurtenant structures taken during the time of inspection are presented on Pages A-1 through A-7 of the Appendix.

b. Dam. The upstream and downstream faces of the dam (see Photo 1 and 2) were found to be in satisfactory condition although some erosion of the unprotected upstream slope at the waterline was noticed. The upstream slope is grass-covered above the eroded section. Some surface erosion or subsidence, to a depth of several inches along the alignment of the center spillway outlet pipe, was noticed in the downstream slope near the toe. The downstream slope was well covered with grass and at the time of the inspection it was about 24 inches high. The dam crest appeared in good condition with only some minor surface shrinkage cracks in several areas adjacent to and parallel to the roadway where the grass cover was sparse. These cracks were, for the most part, less than 12-inches in length, about 1/8-inch in width, and appeared to be about 6-inches in depth.

At the surface and where exposed, the material used to construct the dam appeared to be either a silty clay or a clayey silt. No holes or animal burrows were detected in the face or crest of the dam. No indication of seepage through the dam at the downstream toe of slope or at the abutments was noticed.

A liquid petroleum (LP) tank farm (see Photo 12) with about 60 LP tanks is located on an area at the west side near the downstream toe of slope and an electrical substation (see Photo 13) is located on an area at the east side adjacent to the downstream toe of slope of the dam.

A facility for installation of a pump (see Photo 8) has been constructed on the area near the center of the dam immediately adjacent to the downstream toe of slope. This pump is used to replenish Lake Sainte Louise by pumping water from Lake Saint Louis. The 12-inch outlet pipe for the 42-inch diameter drop inlet spillway at this location has been modified to function as a pump discharge line. A 10-inch cast-iron pipe that serves as the discharge line for the pump is connected to the 12-inch spillway outlet pipe. At the connection to the 12-inch pipe, a gate valve (see Photo 9) has been installed. This valve is normally maintained closed in order to prevent backflow from Lake Sainte Louise. Also, according to the Director of the Lakes and Parks Department, Lake Saint Louis Community Association, the spillway outlet pipe downstream of the pump line connection has been plugged with concrete in order to allow pumpage to flow to Lake Sainte Louise. The location of the pump base and connecting pipe lines is shown on Plate 2. At the time of the inspection, the pump was not installed and water, although the valve was closed, was flowing from the pump discharge connecting line at a rate of about 1-2 gpm. This leakage was collecting in a small pool (see Photo 10) adjacent to the pump base and entering the ground at a point adjacent to the nearby sanitary sewer manhole where it appeared that some of the flow entered the manhole through an open joint in the masonry wall. Although, according to the Director, the valve is normally maintained closed, it has been opened at times by non-authorized individuals living nearby. During these periods when the valve is open, high discharges at the 10-inch pipe have occured and the flow has eroded to a depth of several feet, (see Photo 11) the normal bank at the point where it enters Lake Saint Louis. The location of the eroded bank at Lake Saint Louis is also shown on Plate 2.

c. 42-Inch Diameter Spillway. The 42-inch diameter drop inlet type spillway (see Photo 7) located near the center of the dam appeared to be in good condition although it did have an accumulation of small stones and/or debris lying in the bottom of the inlet. An anti-vortex baffle plate and a screen to prevent trash from entering the inlet had been installed above the open top of the inlet. Both the plate and screen appeared to be in good condition. The operating stem for the gate on a pipe line located out in the

lake and leading to the inlet was disconnected and not operable. Water was standing in the inlet to the same level as the lake. The outlet pipe for this spillway had been modified as indicated in the preceeding paragraph. The condition of this pipe could not be determined since only the top of the pipe at one location (near the 10-inch valve) could be seen.

d. 48-Inch by 102-Inch Rectangular Spillway. The 48-inch by 102-inch drop inlet type spillway (see Photo 3) located at the east end of the dam appeared to be in good condition. The 2-foot high section of stop-log planks on the lake side of the inlet were leaking a negligible amount. An anti-vortex plate and a screen to prevent trash from entering the inlet had been installed above the open top of the inlet. Both the plate and screen appeared to be in good condition. A 36-inch diameter corrugated metal pipe serves as an outlet for this inlet. The 36-inch pipe appeared to be in good condition although the type of joints used could not be determined. The pipe discharges into an open concrete manhole (see Photo 4) located approximately 150 feet from the centerline of the dam near the right abutment. A 15-inch diameter pipe extends approximately 28 feet from the manhole and terminates at an unimproved ditch (see Photo 5). An accumulation of construction debris was observed at the upstream end of the ditch. The ditch continues for about 420 feet before it joins Lake Saint Louis (see Photo 6). The ditch at the upstream and downstream (Lake Saint Louis) ends was extensively eroded, apparently by flow being discharged from the 36-inch diameter outlet pipe.

e. Sanitary Sewer. The sanitary sewer manhole located at about the center of the dam on the area near the downstream toe of slope was visually inspected. Depth of flow in the manhole was on the order of 3 to 4 inches, at 8:00 a.m. on the date of the inspection. As previously mentioned, some water leakage at the valve on the 10-inch pipe installed for a pump connection was observed entering the manhole through joint openings in the masonry wall.

3.2 DEFICIENCIES

Deficiencies observed during the inspection are not of serious potential to warrant immediate remedial action. Recommendations regarding correction of deficiencies reported herein are presented in Section 7 of this report.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

At present, according to the Director of the Lakes and Parks Department, lake surcharge is controlled by overflow of the 48-inch by 102-inch drop inlet spillway located near the east end of the dam. The stop-log planks along the lake side of the inlet are normally kept in place and apparently used only when it is desired to lower the lake level 2 feet or less.

During periods of dry weather and low lake level, according to the Director of Parks and Lakes, a pump, estimated to have a capacity of 1,500 gpm, is installed on the base located on the berm just below the dam and water is pumped from Lake Saint Louis to Lake Sainte Louise to raise the lake level. As indicated in Section 3, the 12-inch outlet pipe for the 42-inch diameter drop inlet spillway is utilized as the pump discharge line.

4.2 MAINTENANCE OF DAM

The grass on the upstream slope of the dam is cut frequently during the growing season. The grass on the downstream slope, according to the Director, is cut occasionally because of the steepness of the slope. The roadway traversing the dam crest has an asphalt surface and is well maintained. Curb inlets for the collection of surface runoff are located at intervals along the roadway. Runoff collected by this drainage system is discharged to Lake Sainte Louise.

4.3 MAINTENANCE OF SPILLWAYS

It was reported by the Director that both drop inlet type spillways are periodically cleaned of debris. The outlet channel downstream of the 36-inch

outlet pipe for the 48-inch by 102-inch spillway is unimproved and not maintained. The valve on the 10-inch pump discharge line of the modified outlet pipe for the 42-inch spillway is, according to the Director, in operating condition although it leaks moderately when in the closed position.

4.4 WARNING SYSTEM

There is no warning system in effect in case of extreme high water and possible overtopping of the dam. With a very frequently traveled road traversing the dam and the presence of numerous home owners in the dam vicinity, it is likely that adequate warning of overtopping of the dam would be given if such a condition was developing.

4.5 EVALUATION

Revisions to the outlet pipe of the 42-inch diameter drop inlet spillway have rendered its reliability as an outlet questionable since discharge depends on opening the valve that is located on the berm below the dam. Since this outlet provides only about 10 percent of the total capacity of both drop inlet spillways, and since this quantity is considerably less than that required for spillway design flood, the potential loss of this spillway outlet is not considered significant.

The presence of full time employees under responsible supervision, as is the case at Lake Sainte Louise, to maintain and inspect the dam and appurtenances, is considered beneficial to the safety of the dam.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. No detailed design data was available for review. The preliminary hydrologic/hydraulic design by R. W. Booker & Associates, Inc., recommended a 50 acre lake, with normal lake level at elevation 541.0, top of dam at elevation 552.4, and a 50-foot long spillway designed to pass the probable maximum flood (PMF).

However, surveys made at the time of the visual inspection indicated that the lake, dam and spillways as constructed were considerably different from those comtemplated in the preliminary design report. The lake has a surface area of about 72-acres at normal pool, elevation 545.3.

Two drop inlet type spillways (48-inch by 102-inch rectangular with a 36-inch pipe outlet, and 42-inch circular with a 12-inch pipe outlet) were provided. The overflow level of both drop inlets is about elevation 545.3. The low point in the roadway just east of the right abutment is about elevation 547.3 and will function as an emergency spillway to about elevation 548.3, the elevation at which lake outflow will overtop the dam in the vicinity of the right abutment.

b. Experience Data. The drainage area and lake surface area were developed from the USGS Wentzville, Missouri Quadrangle Map. The dam and spillway layouts were obtained from Lake Saint Louis study drawings and surveys made during the inspection.

c. Visual Observations.

(1) The drop inlet spillways and outlet pipes are in satisfactory condition. According to the Director of the Lakes and Parks Department, channel

improvements downstream of the outlet manhole on the 36-inch pipe outlet, consisting of the installation of a pipe to carry frequent low volume lake outflows, are planned by the owner.

(2) Drawdown facilities to completely dewater the lake are not provided. A pipe extending into the lake and leading to the 42-inch spillway is believed to have been capable at one time of allowing the lake to be lowered about 4 feet below normal pool level. However, modifications to this spillway and present operating methods no longer allow this outlet to function as originally intended. The lake can be lowered about 2 feet by removal of the stoplog planks at the 48-inch by 12-inch spillway.

(3) The 48-inch by 102-inch drop inlet spillway and 36-inch pipe outlet are located at the east end of the dam. The 42-inch diameter drop inlet spillway and 12-inch pipe outlet are located near the center of the dam. Spillway releases within the capacity of the spillways will not endanger the integrity of the dam.

(4) The low area east of the right abutment, when required, will function as an emergency spillway to about elevation 548.3 before lake outflow begins to overtop the dam. However, flow over this spillway will undoubtedly cause damages to a few lots, including homes on these lots, if present. Although this spillway outlet area appears, from the inspection, to be in undisturbed ground, discharges within the capacity of the emergency spillway are expected to cause damage to the area by erosion in excess of that presently experienced from discharge of the 36-inch outlet.

d. Overtopping Potential. The total capacity of the two drop inlet spillways and the emergency spillway is too small to pass the outflow from the Probable Maximum Flood or the 1/2 Probable Maximum Flood, but will pass outflow from the 1 percent chance (100-year frequency) flood without overtopping the dam. The results of a dam overtopping analysis are as follows:

Ratio of PMF	Q - Peak Outflow (cfs)	Max. Lake Water Surface Elev.	Max. Depth of Flow Over Dam (Elev. 548.3)	Duration of Overtopping of Dam (Hours)
0.22	640	548.3	0	0
0.50	3,250	549.4	1.1	4.3
1.0	7,400	550.2	1.9	7.0
100-Year Flood	540	548.2	0	0

The flow safely passing the drop inlet and emergency spillways just prior to overtopping amounts to about 640 cfs, which is the outflow equivalent to about 22 percent of the Probable Maximum Flood, but exceeds the 1 percent chance (100-year frequency) flood.

Procedures and data for determining the Probable Maximum Flood, the 100-year frequency flood, and the discharge rating curve for flow over the spillways and dam crest are presented on Pages B-1 and B-2 of the Appendix. A listing of the HEC-1DB input data is shown on Pages B-3 through B-5 of the Appendix.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. No evidence of instability of the dam or seepage at or near the downstream toe of dam, the abutments, or elsewhere was evident during the visual inspection. No mention of slides or other signs of instability were reported by the owner.

b. Design and Construction Data. Design or construction data relating to the structural stability of the dam was not available for review.

c. Operating Records. No appurtenant structures requiring operation presently exist at this dam. The pipe allowing the lake to be lowered about 4 feet no longer functions as intended due to changes to the 42-inch spillway outlet pipe and method of operation. No records have been kept of lake level, spillway discharge, dam settlement, or seepage during the post construction period.

d. Post Construction Changes. According to the Director of the Parks and Lakes Department and to the best of his knowledge, since completion of the dam and appurtenances, the only significant change has been the modifications made to the outlet pipe of the 42-inch diameter drop inlet spillway.

e. Seismic Stability. Since this dam is located within a Zone II seismic probability area, an earthquake of the magnitude predicted is not expected to produce a hazardous condition to the dam provided that static stability conditions are satisfactory and conventional safety margins exist.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. A hydrologic/hydraulic analysis indicated that, for floods requiring lake outflow greater than 640 cfs (outflow for maximum probable flood would be approximately 7,430 cfs and for the 1 percent chance [100-year frequency] flood would be approximatley 540 cfs), the dam and part of the east abutment will be overtopped.

Data available at this time did not reveal that stability or seepage analyses of the dam had been performed.

b. Adequacy of Information. Due to the lack of engineering design and construction data, the assessments reported herein were based on performance, history and external conditions as determined during the visual inspection. This information is believed adequate to support the conclusions herein. Those recommendations with regard to the hydrology of the lake and the hydraulic capacity of the spillways are based on a study of the area and the outlets as indicated in Section 5.

c. Urgency. The safety deficiency stated in Paragraph 7.1a pertaining to overtopping of the dam should be investigated without delay. The stability and seepage analysis are not considered to be of urgent necessity since the dam has already experienced near maximum surcharge (lake level below dam crest by 1.3 feet) conditions without showing signs of instability. The remedial measures recommended in Paragraph 7.2 should be accomplished in the near future.

d. Necessity for Phase II. Based on the findings and assessment of the safety of the dam developed during this investigation, a Phase II study is not recommended.

e. Seismic Stability. The Lake Sainte Louise dam is located in seismic Zone II. An earthquake of the magnitude predicted for this zone is not expected to be hazardous to the dam provided static stability conditions are satisfactory and conventional safety margins exist.

7.2 REMEDIAL MEASURES

a. Recommendations. The following actions are recommended:

(1) Spillway capacity and/or height of dam should be increased to pass the probable maximum flood without overtopping the dam. It may be that, if and when the probable maximum flood occurs, the flow over the spillway would cause damages to several homes located on the opposite bank of Lake Saint Louis. This possibility should be investigated. Further, it is advised that the lake replenishment system (pump, suction and discharge lines) be independent of the spillway(s).

(2) Obtain the necessary soil data and perform seepage and stability analyses to assess the stability of the dam for conditions which the dam has not experienced.

(3) A review of the available records for the sanitary sewer line under the dam did not reveal the kind of pipe material used or the type of joints required. Further, it could not be determined if collars were constructed along the line beneath the dam to provide obstruction to seepage flow. Also, there appears to be no provision on the upstream side of the dam to isolate the sanitary sewer should failure or other problems occur in the sewer beneath the dam. The owner should address these deficiencies and take the necessary corrective measures.

(4) Determine the nature of the subsidence and/or erosion on the downstream slope of the dam along the alignment of the 12-inch outlet pipe for the 42-inch diameter spillway and take the necessary corrective action. The kind

and type of pipe and pipe joints used for the 12-inch pipe should be determined and their suitability for this installation investigated.

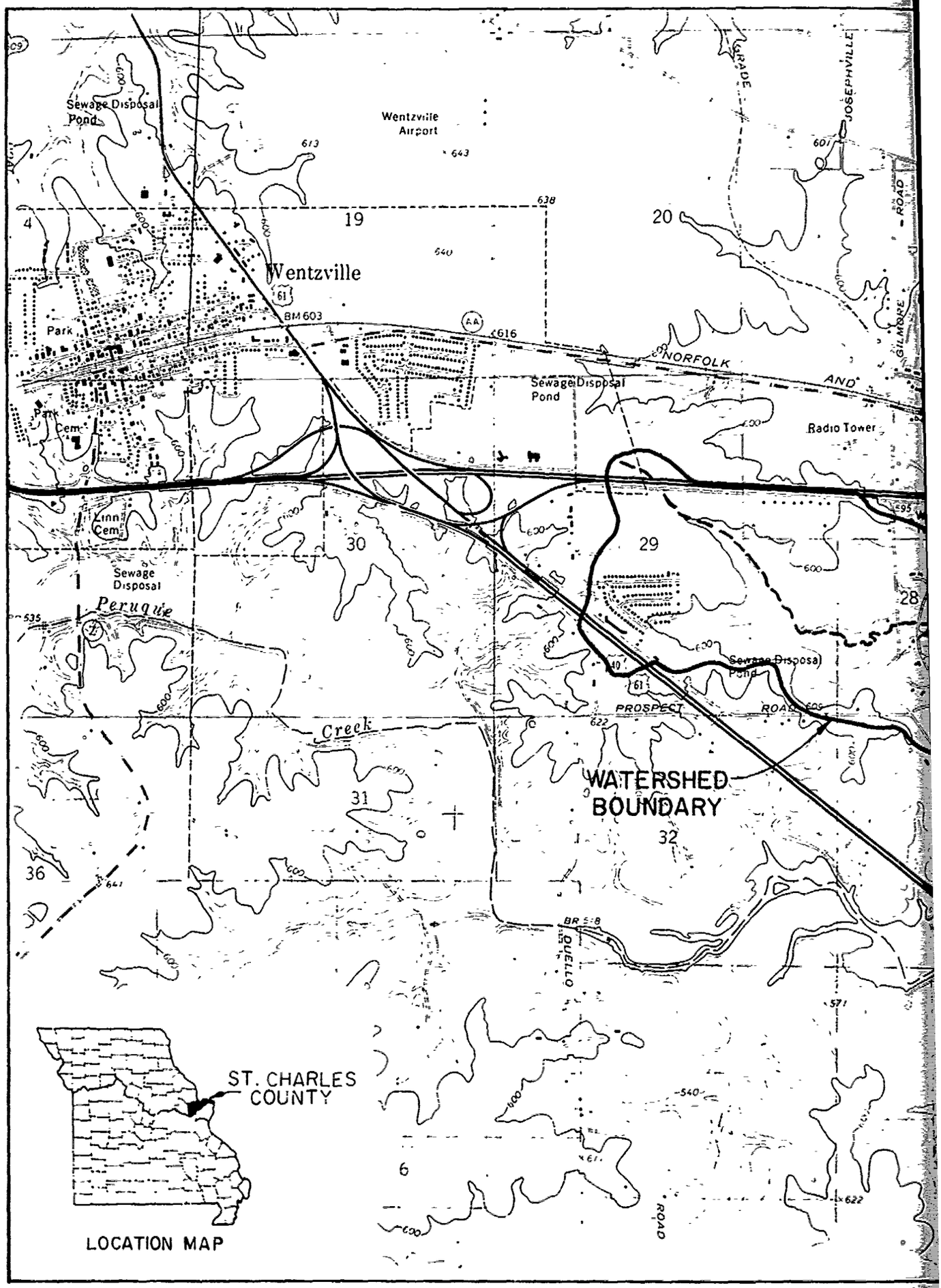
b. O & M Maintenance and Procedures. The following O & M maintenance and procedures are recommended:

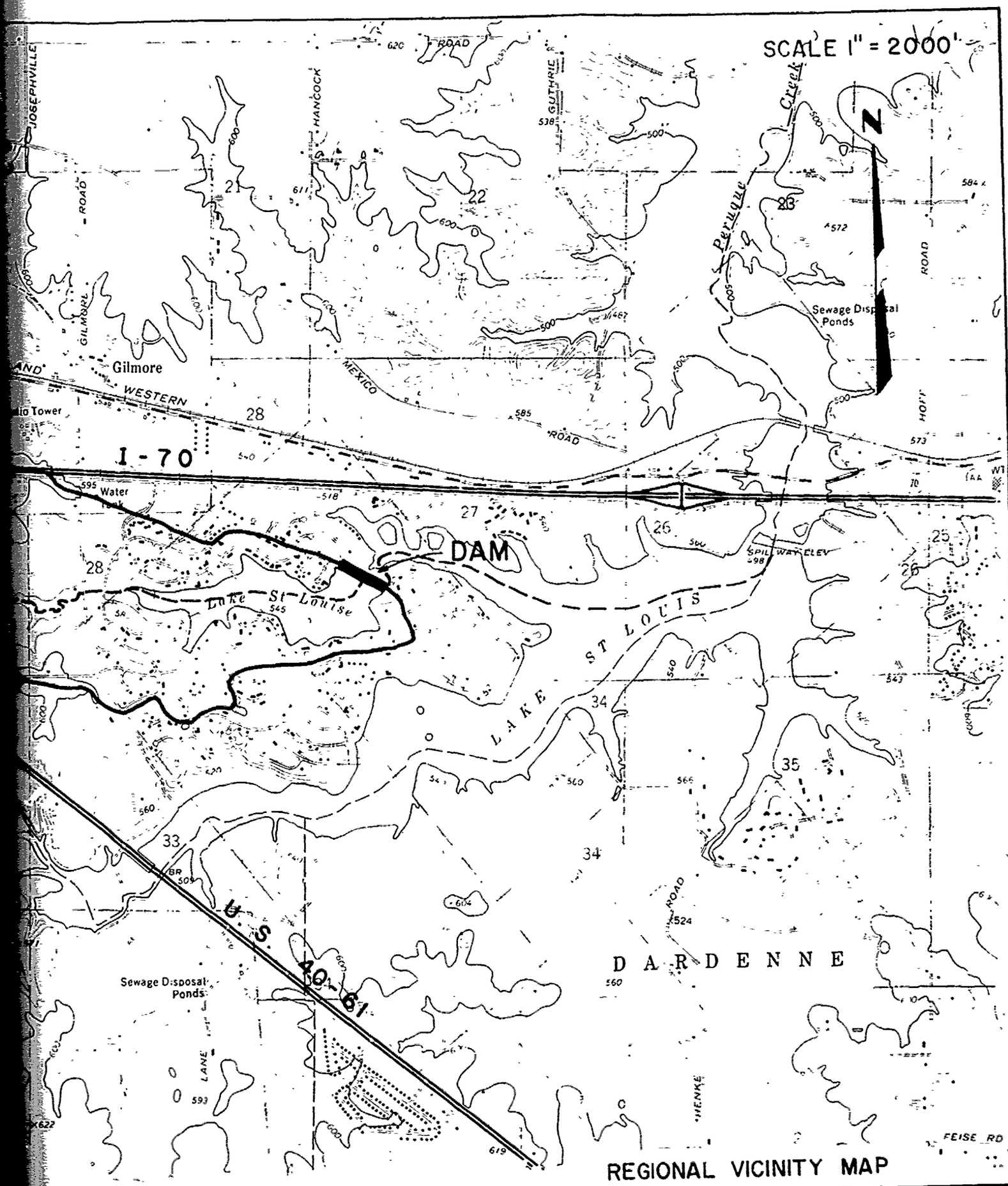
(1) Provide some form of slope protection on the upstream face of the dam to prevent erosion of the slope at the waterline due to wave action or fluctuations in the water surface level.

(2) Cut grass on downstream slope of dam more frequently. Grass should not be allowed to grow to a height that hinders inspection of the dam and provides cover for burrowing animals.

(3) Provide protection at the shore line of lake Saint Louis and elsewhere to prevent erosion by spillway discharges from Lake Sainte Louise.

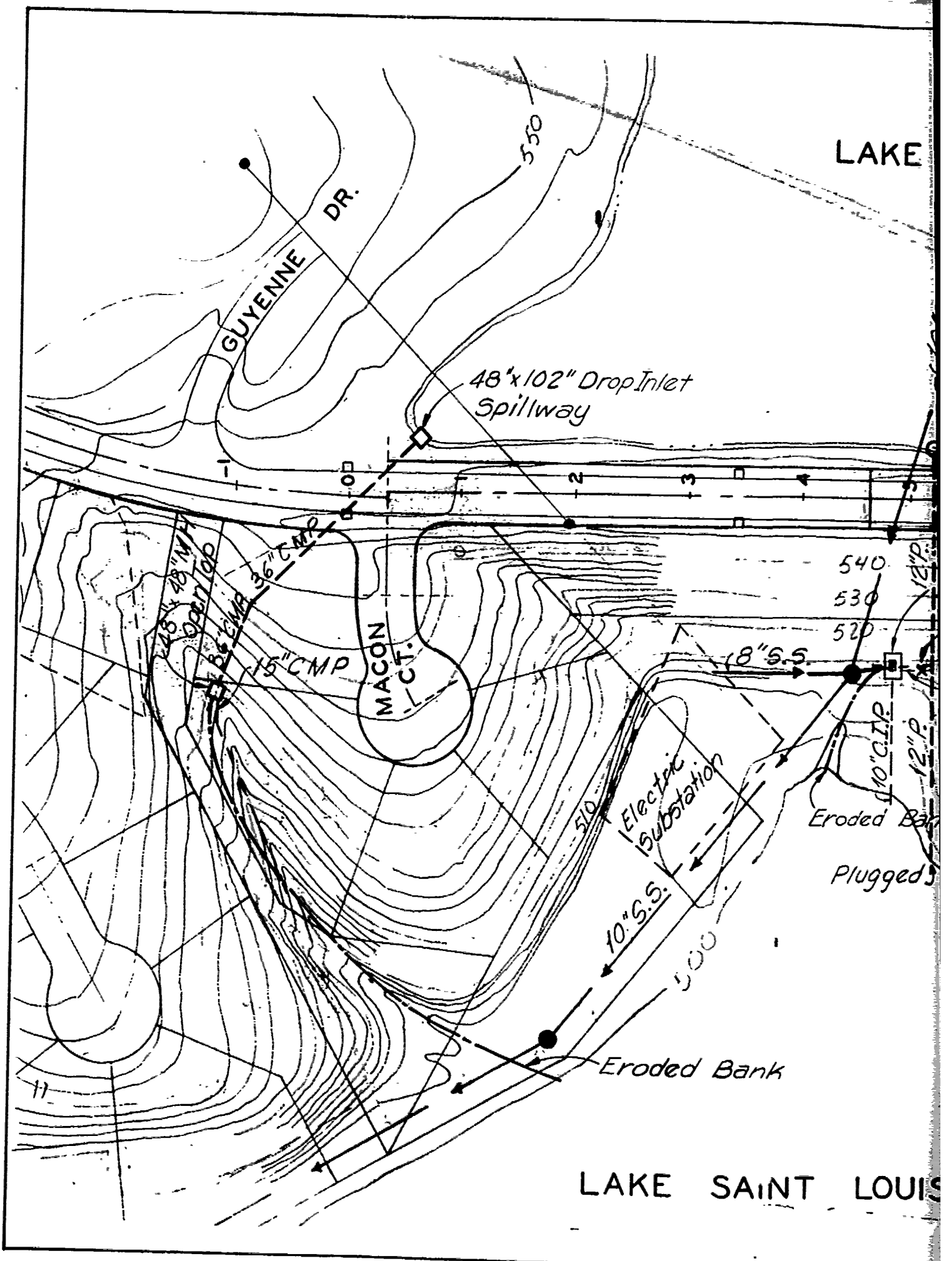
(4) Restore the 42-inch spillway to its original condition by closing the valve on the lake inlet pipe and unblocking the outlet pipe. This will allow the spillway to function as originally intended (as long as the valve on the pump connecting line is closed or the line blocked) and will eliminate the condition of having the 12-inch outlet pipe under permanent head. The purpose of this recommendation is to eliminate a condition considered undesirable under any circumstances and will not increase spillway capacity as recommended in paragraph 7.2a(1). It will, however, improve the reliability of this spillway since it will not be necessary to open the valve on the pump connecting line in order to allow the outlet pipe to be serviceable.

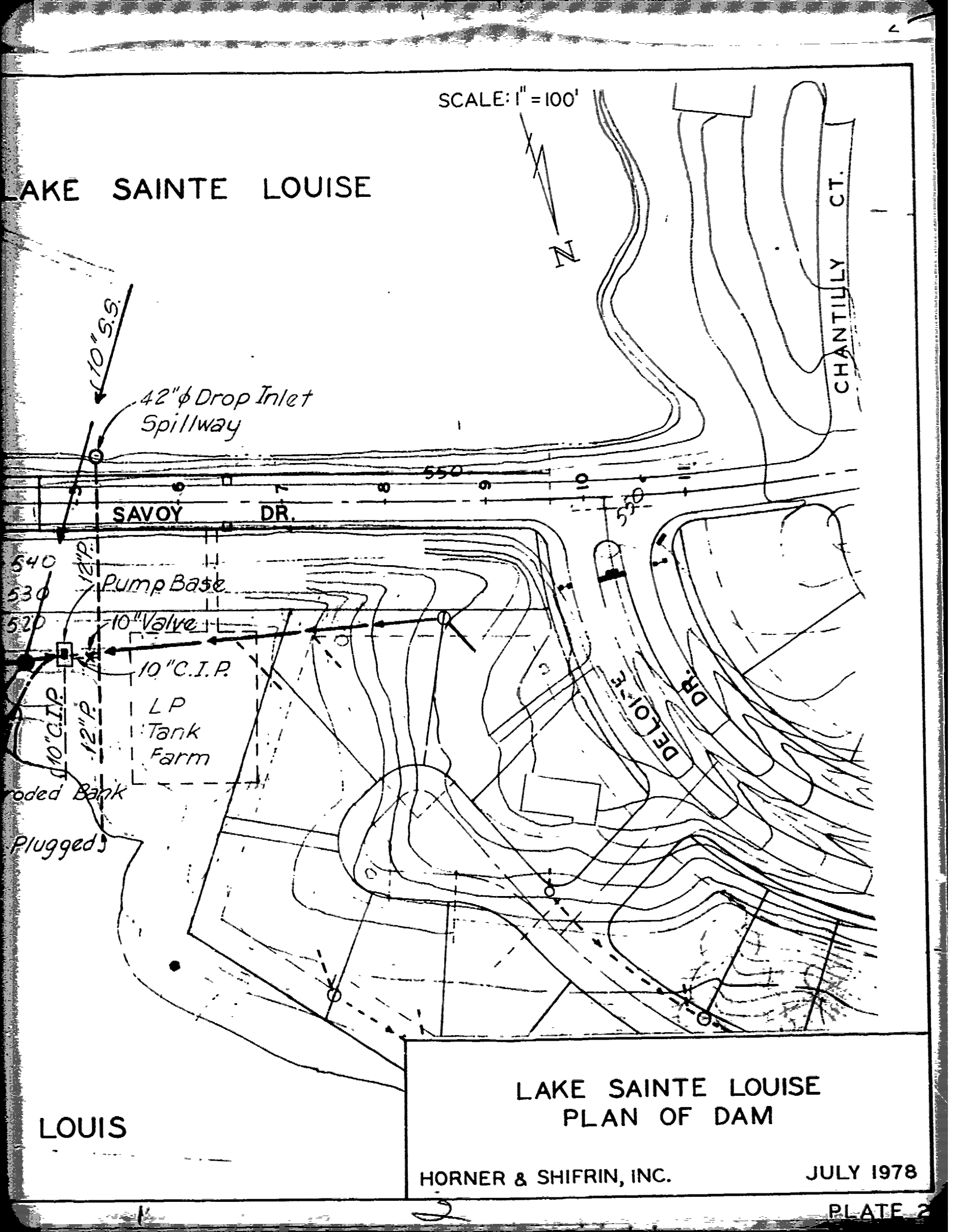

Sewage Disposal Pond
Wentzville Airport
Wentzville
BM 603
Park
Park
Cem.
Linn Cem.
Sewage Disposal
Peruque
Creek
Sewage Disposal Pond
Radio Tower
NORFOLK AND
Sewage Disposal Pond
PROSPECT ROAD
WATERSHED BOUNDARY
BR 5-8
QUELLO
ROAD
JOSEPHVILLE
GILMORE ROAD
4
19
20
30
29
28
31
32
36
6
ST. CHARLES COUNTY
LOCATION MAP



REGIONAL VICINITY MAP

PLATE 1


LAKE
GUYENNE DR.
550
48"x102" Drop Inlet
Spillway
48"x48" M.H.
Drop Top
36" CMP
15" CMP
MACON
C.L.
540
530
520
8" S.S.
12" P.
Electric
Substation
510
10" S.S.
Eroded Bank
Plugged
LAKE SAINT LOUIS

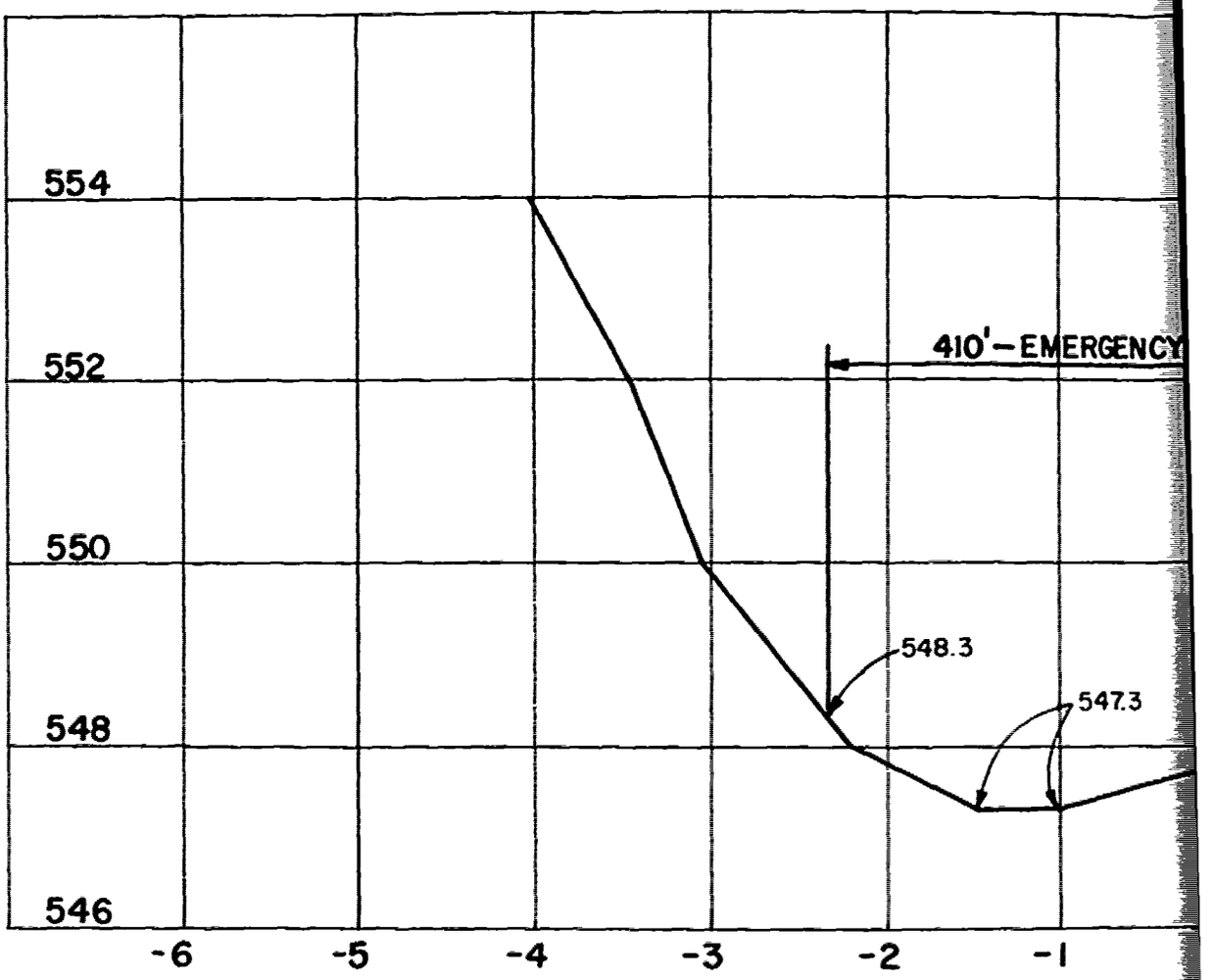


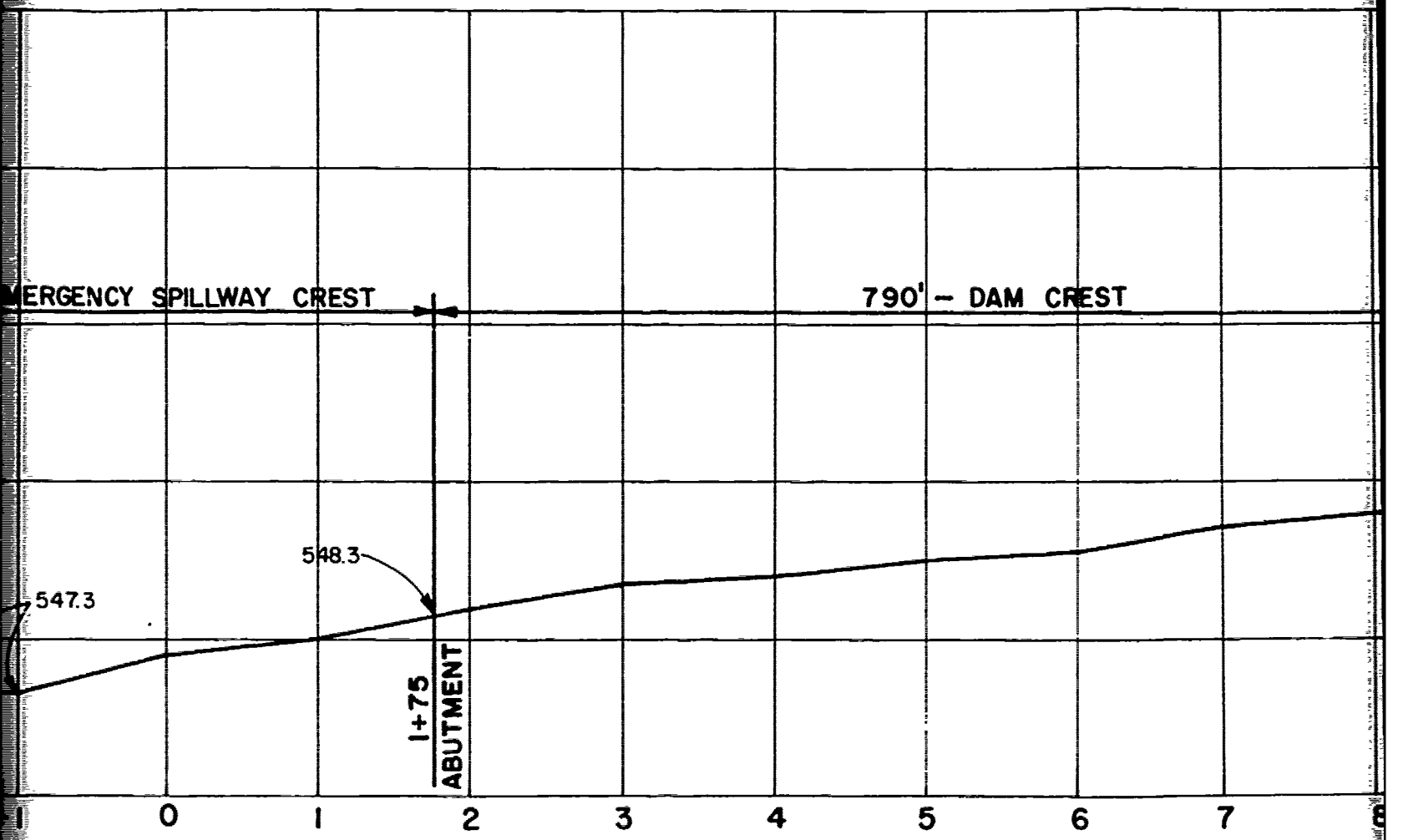
LAKE SAINTE LOUISE
PLAN OF DAM

HORNER & SHIFRIN, INC.

JULY 1978

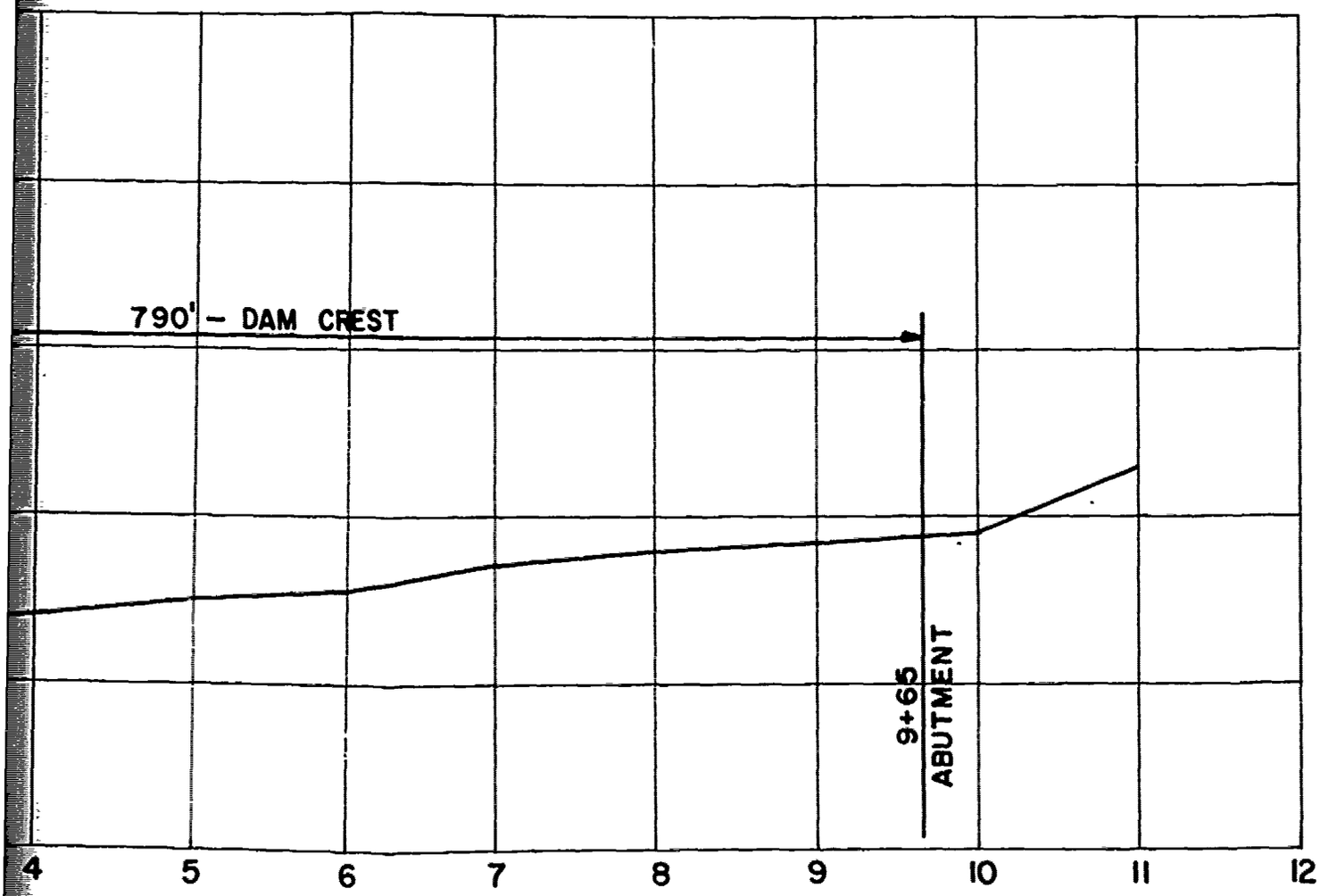
PLATE 2


554
552
550
548
546
-6
-5
-4
-3
-2
-1
410'-EMERGENCY
548.3
547.3



PROFILE

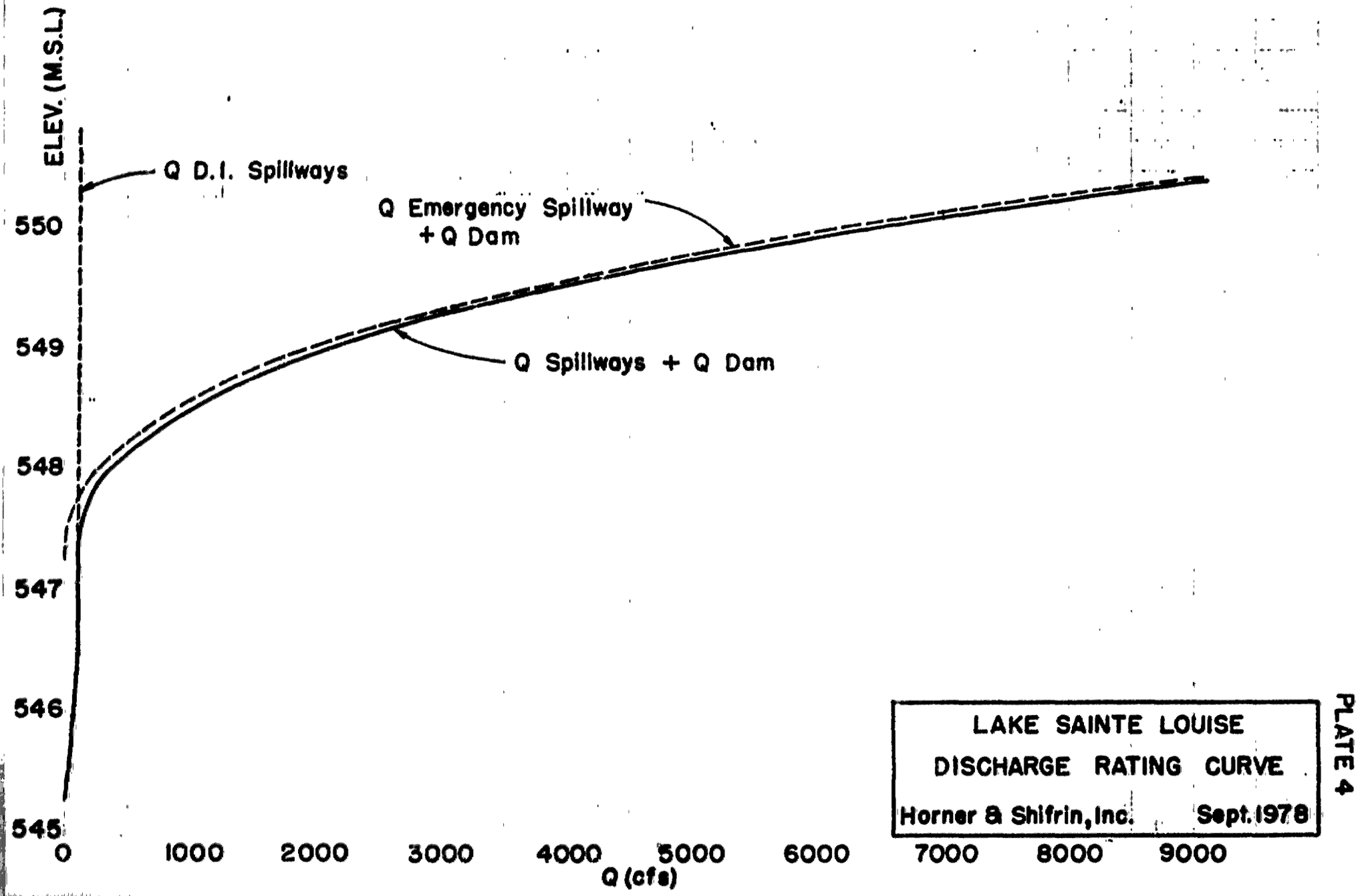
SCALES: 1"= 2' V., 1"= 100' H.



LAKE SAINTE LOUISE
DAM & EMERGENCY SPILLWAY PROFILE

Horner & Shifrin, Inc. Sept. 1978

PLATE 3



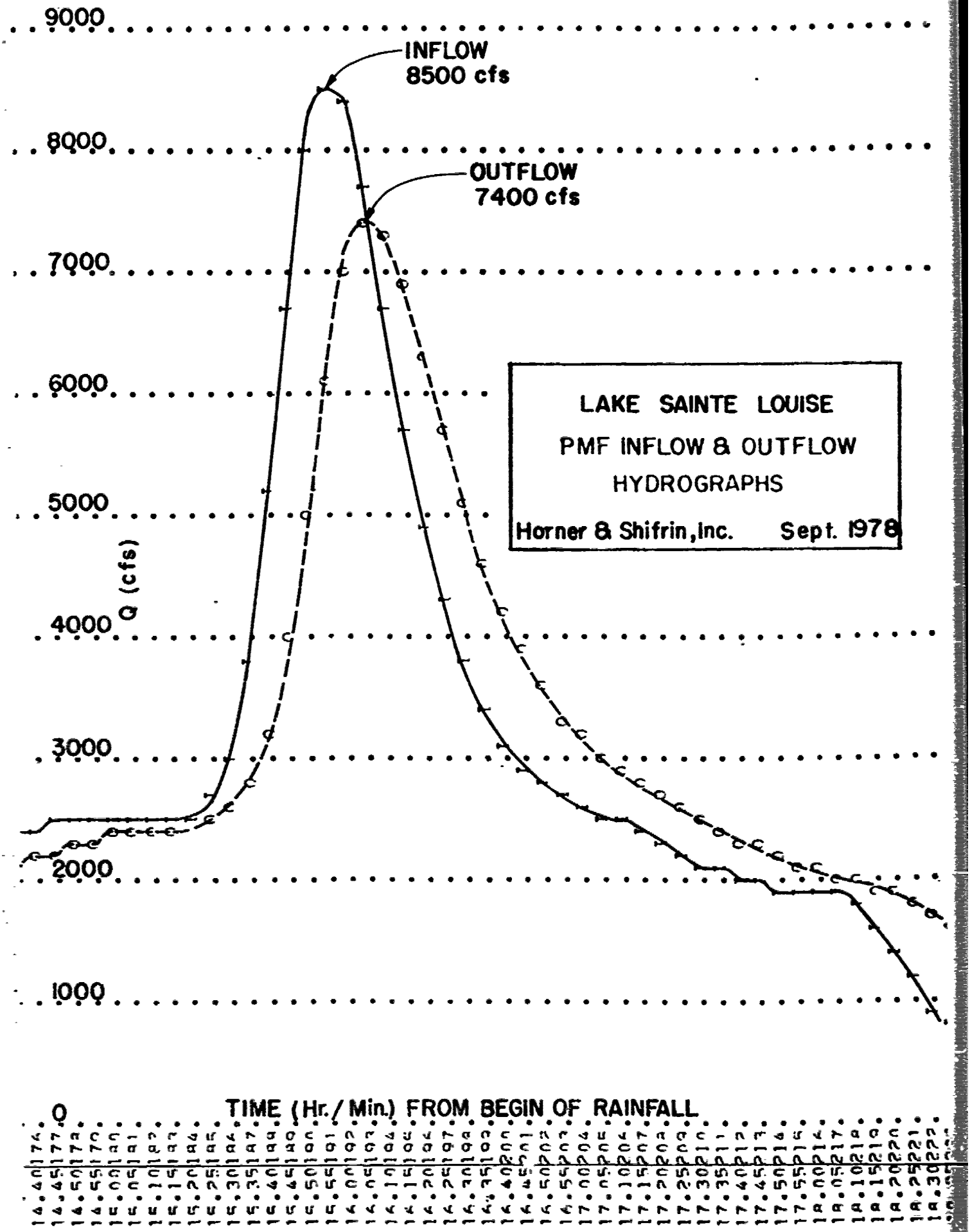
LAKE SAINTE LOUISE

DISCHARGE RATING CURVE

Horner & Shifrin, Inc. Sept. 1978

PLATE 4

PLATE 5


9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Q (cfs)
INFLOW
8500 cfs
OUTFLOW
7400 cfs
LAKE SAINTE LOUISE
PMF INFLOW & OUTFLOW
HYDROGRAPHS
Horner & Shifrin, Inc. Sept. 1978
TIME (Hr./Min.) FROM BEGIN OF RAINFALL

SUBSURFACE INVESTIGATION
AND
LABORATORY ANALYSIS

FOR

PETITE LAKE ST. LOUIS DAM PROJECT
OF
LAKE ST. LOUIS INVESTMENT CORP.
O'FALLON, MISSOURI

BY

BROWNING TESTING LABORATORIES, INC.
ROUTE #2, HWY. 54 NORTH
FULTON, MISSOURI 65251
PHONE (314) 642-5719

BROWNING TESTING LABORATORIES, INC.
ROUTE 3, HWY. 54 NORTH - - PHONE MI 2-5719
FULTON, MISSOURI 65251

Manager
GARY N. CLARK

President
BERNARD G. BROWNING

October 13, 1966

Lake St. Louis Investment
Corporation
Route 12
O'Fallon, Missouri

Re: Subsurface investigation and laboratory Analysis of Lake St. Louis Dam Site.

Gentlemen:

We have completed the subsurface investigation and laboratory analysis of the work referenced.

Enclosed, you will find copies of the drilling logs and explanations of the method of classification, a plot showing the depths and location of borings along the center line of the dam, and laboratory data sheets showing compaction data and atterberg limits.

The soil type at the dam site is Winfield, generally a smooth brown silt loam to a silty clay and containing some chert, gravel and sand.

The geological location is of the Kaskaskia formation as is indicated in the Geologic Report presented by Mr. James H. Williams, and incorporated in this report.

The soil type from the borrow area above the dam site is Union, generally a reddish to brownish silty clay to clay with residual chert scattered throughout.

Samples of the boring are maintained on file until the job is completed or abandoned, feel free to see them at any time.

Respectfully yours,
Gary N. Clark
Gary N. Clark, Manager

GNC:ajb

cc:James H. Williams

Chart 2-2

BERNARD G. BROWNING
PROFESSIONAL ENGINEER & LAND SURVEYOR
ROUTE 2, HWY. 54 NORTH - - PHONE MI 2-5719
FULTON, MISSOURI 65251

Member
N.S.P.E.
M.S.P.E.
M.A.R.L.S.
A.C.S.M.

Missouri
Registration
E-7795
LS-559

October 19, 1966

Lake St. Louis Investment, Corp.
Route #2
O'Fallon, Missouri

Gentlemen:

The following is a preliminary Engineering Report of your Petite Lake St. Louis Dam Project.

The Geological Report, Drill Logs, and field investigation all indicate that you have a feasible project.

It is suggested that if fishing is anticipated in the fall of 1967 that construction proceed this fall with a target completion date of Dec. 20, 1966.

Good construction will be the key to success for this project. The core trench excavation will require hand work and possibly some blasting at the juncture of the soil and bedrock. This is the critical area.

In general the preliminary design criteria is as follows:

Top width of dam	30 feet
Top elevation of dam	548.0
Side slopes of dam upstream	2.5 to 1.0
Side slopes of dam downstream	2.5 to 1.0
Core trench, bottom width	20.0 ft.
Core trench, side slopes	1.0 to 1.0
Principal spillway elevation	543.0

The laboratory tests show that the soil classified as silt loam has a liquid limit of 23 percent moisture. This means that this fill material is to be used with caution. It can be used in the down stream section above the Big Lake St. Louis waterline.

We are awaiting your decision about going ahead on the final design.

Very truly yours,

Bernard G. Browning

BGBiajb

Chart 2-3

GEOLOGIC REPORT ON THE ST. LOUIS LAKE (BROWNING), ST. CHARLES COUNTY

The proposed lake site is located in the SW¼ NW¼ SE¼ sec. 27, T.47 N., R.2 E. (Troy Quad.). Geologically the location is excellent for water impoundment. The bedrock formation, Keokuk Limestone, is present in the valley area but crops out in very few exposures along the steeper portions of the valley slopes. The Keokuk has limestone beds that are thin to medium in thickness (4" to 2') and interlayered with persistent thick nodules of chert that are in 2" to 6" beds. Most of the valley is covered by a thick mantle of silty clay mixed with chert fragments.

While geologically the area is suitable and there are no major hazards, particular attention must be given to the abutments and valley floor at the dam site. Weathered bedrock exposed near the abutments indicate that seepage could occur along horizontal openings if these are not intercepted by the core trench. Location of the centerline so that small side valley draws can be utilized as part of the abutment core trench will facilitate excavation into fresh unweathered bedrock. Similarly excavation along the floor of the valley should be carried through the weathered bedrock zone. The bedrock excavation may require the use of a rear mounted ripper. It is most important that all weathered bedrock layers in the core be removed even if it should require some drilling and blasting.

During the field examination it was considered that the dam site should be shifted upstream so that the side valley draws could be utilized. This upstream relocation also placed the dam on a more shallow thickness of alluvium than at the originally proposed downstream site. This will further enhance the suitability of the site since it will be easier to complete the core trench excavations. Greater thickness of alluvium such as the downstream site generally involve the problems of more permeable zones consisting of gravels and boulders.

Since subsurface exploration has outlined the nature of the subsoil and bedrock so that major seepage hazards have been noted and a positive cutoff core is planned borrow may be obtained from areas most convenient from an engineering design viewpoint.

James H. Williams
Engr.

James H. Williams
Chief, Eng. Geol. Section
Missouri Geological Survey
September 30, 1966

Table I—Percentage of Sand Size in Subclasses of Sand, Loamy Sand and Sandy Loam Basic Textural Classes as Defined by the U.S. Department of Agriculture

Subclass	Soil separates				
	Very coarse sand, 2.0-1.0 mm.	Coarse sand, 1.0-0.5 mm.	Medium sand, 0.5-0.25 mm.	Fine sand, 0.25-0.1 mm.	Very fine sand, 0.1-0.05 mm.
Coarse sand	25% or more		Less than 50%	Less than 50%	Less than 50%
Sand	25% or more			Less than 50%	Less than 50%
Fine sand	Less than 25%		—or—	50% or more	Less than 50%
Very fine sand					50% or more
Loamy coarse sand	25% or more		Less than 50%	Less than 50%	Less than 50%
Loamy sand	25% or more			Less than 50%	Less than 50%
Loamy fine sand	Less than 25%		—or—	50% or more	Less than 50%
Loamy very fine sand					50% or more
Coarse sandy loam	25% or more		Less than 50%	Less than 50%	Less than 50%
Sandy loam	Less than 25%	30% or more	—and—	Less than 30%	Less than 30%
Fine sandy loam	Between 15 and 30%		—or—	30% or more	Less than 30%
Very fine sandy loam	Less than 15%		—or—	More than 40%*	30% or more

*If of fine sand and very fine sand must be very fine sand.

Sandy loams: Consists largely of sand but has enough silt and clay present to give it a small amount of stability. Individual sand grains can be seen and felt readily. Squeezed in the hand when dry, it will fall apart when the pressure is released. Squeezed when moist, it will form a cast that will not only hold its shape when the pressure is released but will withstand careful handling without breaking. The stability of the moist cast differentiates this soil from sand.

Loam: Consists of an even mixture of the different sizes of sand and of silt and clay. It is easily crumbled when dry and has a slightly gritty, yet fairly smooth feel. It is slightly plastic. Squeezed in the hand when dry, it will form a cast that will withstand careful handling. The cast formed of moist soil can be handled freely without breaking.

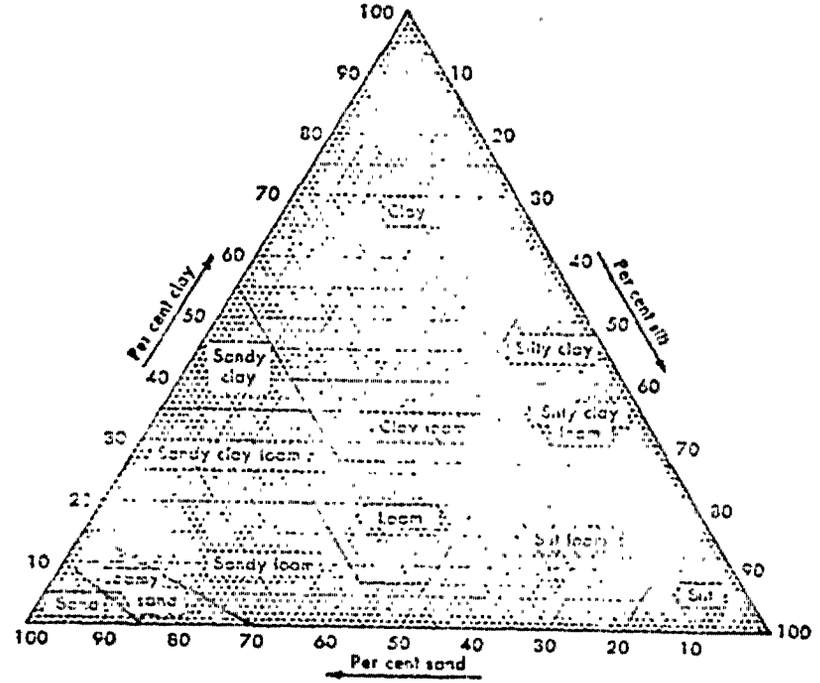


Fig. 2. **U.S. Department of Agriculture textural classification chart for 2-micron clay.**

Silt loam: Consists of a moderate amount of fine grades of sand, a small amount of clay and a large quantity of silt particles. Lumps in a dry, undisturbed state appear quite cloddy but they can be pulverized readily; the soil then feels soft and floury. When wet, silt loam runs together

Copied From Farthest Ahead Fish Soil Primer

BROWNING TESTING LABORATORIES, INC.
Route 2, Hwy. 54 North
FULTON, MISSOURI 65251
(314) MI 2-5719

DATA SUMMARY SHEET

#157

LABORATORY TESTS

ATTERBERG LIMITS:	%	%	%
HOLE NO.	12	12	13 - 14
DEPTH FT.	0 - 10.0	10.0 - 15.0	0 - 7.0
LIQUID LIMIT	28	49	55
PLASTIC LIMIT	20	17	24
PLASTIC INDEX	8	32	31
SHRINKAGE LIMIT			

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Route 2, Hwy. 54 North
FULTON, MISSOURI 65251
(314) MI 2-5719

GENERAL EXPLANATION OF FIELD BORING LOGS

consistency	number of blows	estimated unconfined compression P.S.F.	field identification
very soft	0 - 2	0 - 500	easily penetrated several inches by fist
soft	2 - 4	500 - 1000	easily penetrated several inches by thumb
medium	5 - 8	1000 - 2000	can be penetrated several inches with moderate effort
stiff	9 - 15	2000 - 4000	readily indented by thumb but penetrated only with great effort
very stiff	16 - 30	4000 - 8000	readily indented by thumbnail
hard	30+	8000+	indented with difficulty by thumb nail

Chart 2-7

Silt loam: Soil material that contains 50 per cent or more silt and 12 to 27 per cent clay; (or) 50 to 80 per cent silt and less than 12 per cent clay.

Silt: Soil material that contains 80 per cent or more silt and less than 12 per cent clay.

Sandy clay loam: Soil material that contains 20 to 35 per cent clay, less than 28 per cent silt and 45 per cent or more sand.

Clay loam: Soil material that contains 27 to 40 per cent clay and 20 to 45 per cent sand.

Silty clay loam: Soil material that contains 27 to 40 per cent clay and less than 20 per cent sand.

Sandy clay: Soil material that contains 35 per cent or more clay and 45 per cent or more sand.

Silty clay: Soil material that contains 40 per cent or more clay and 40 per cent or more silt.

Clay: Soil material that contains 40 per cent or more clay, less than 45 per cent sand and less than 40 per cent silt.

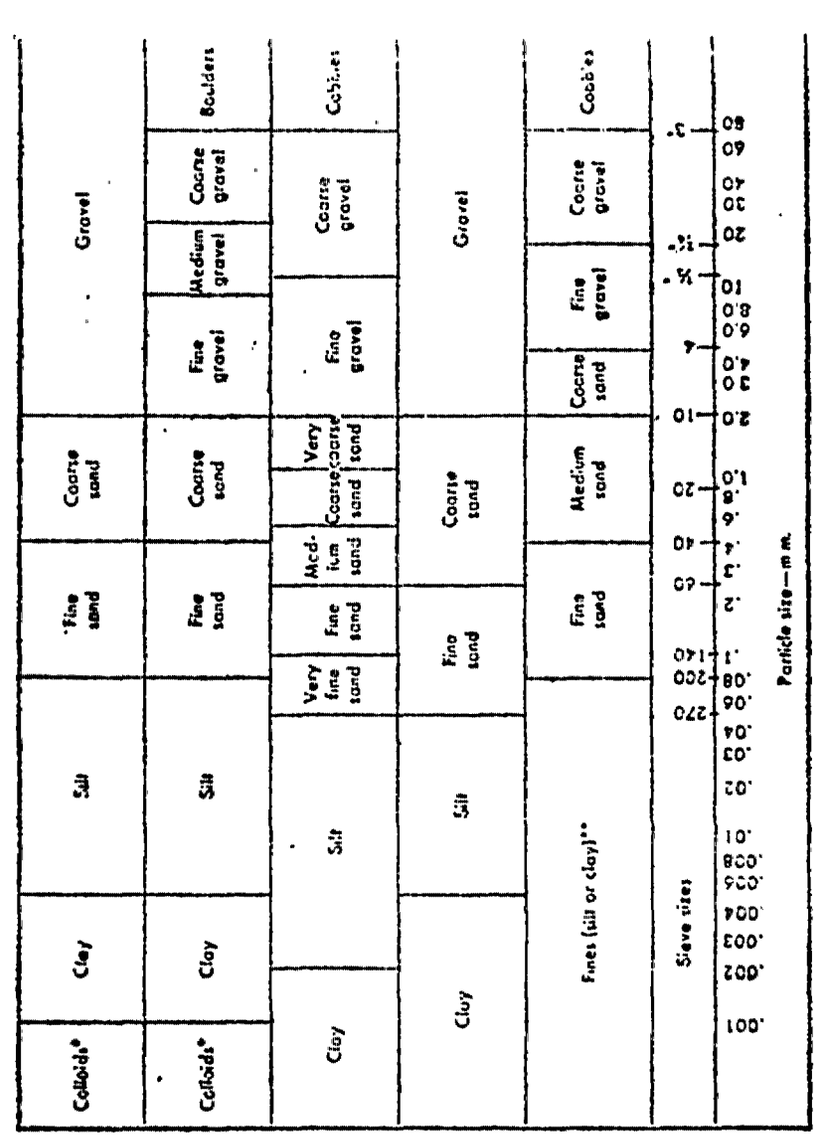
Field identification of texture

Identification of the texture of a soil in the field by feel and appearance requires training and experience. Many engineers acquire this knowledge in the soil laboratory where they conduct the tests for grain size of a soil, plot the results on a triaxial chart and determine the appropriate texture; and then return to the soil tested, mold it in their hands and rub it, both wet and dry, between their fingers while studying its appearance and feel.

To permit approximate textural classification, many practical shortcuts can be devised to determine the amount of silt and clay in a soil. However, since the range in clay content for the textural groups is not large, accurate weighing of samples is needed, which requires some laboratory facilities.

The following brief comments on the feel and appearance of the textural groups given previously illustrate the factors used in determining the texture of a soil in the field and will also assist in field classification work. Note that forming a cast of soil, dry and moist, in the hand and pressing a moist ball of soil between the thumb and finger constitute two major field tests used to judge soil texture.

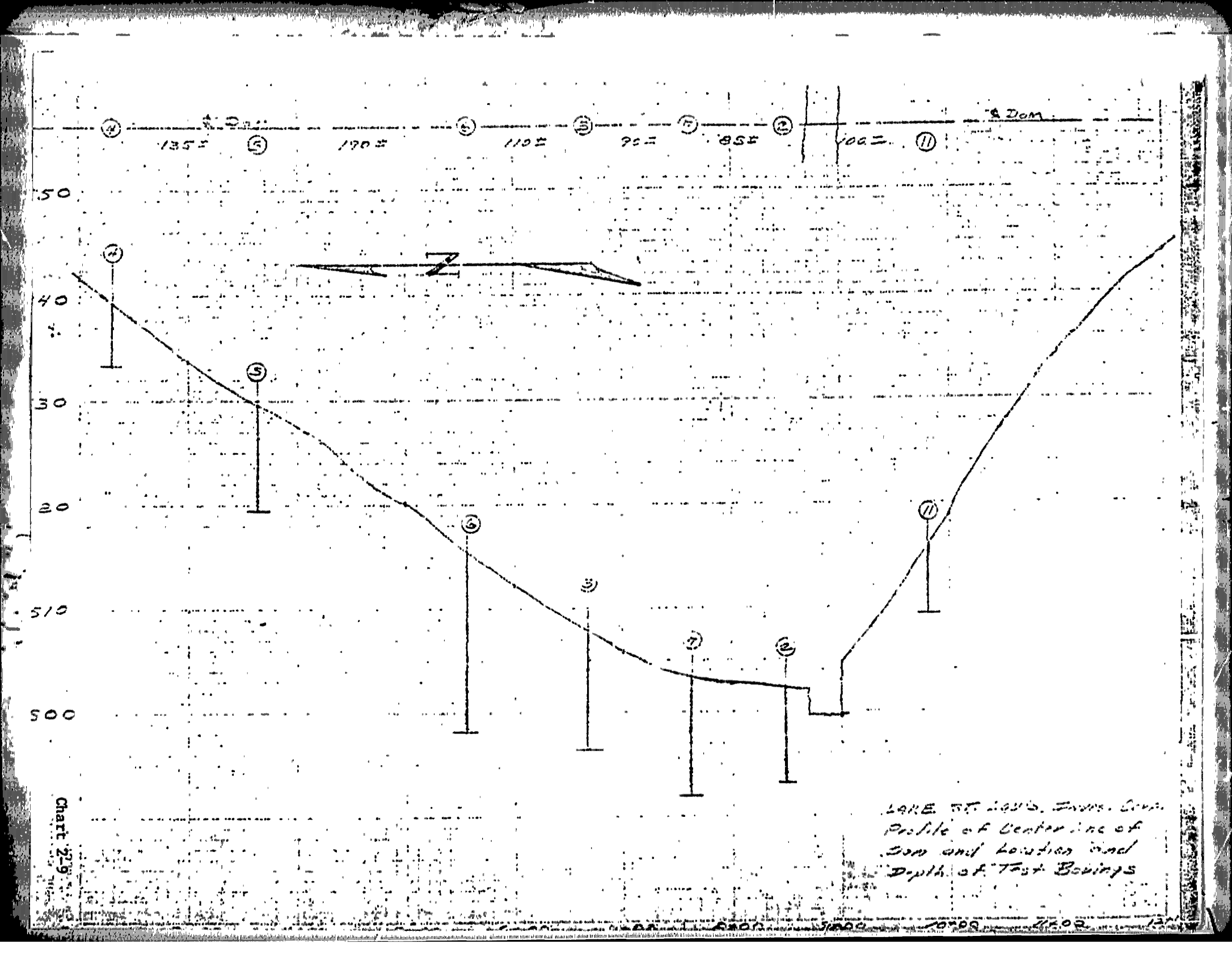
Sand: Individual grains can be seen and felt readily. Squeezed in the hand when dry, it will fall apart when the pressure is released. Squeezed when moist, it will form a cast that will hold its shape when the pressure is released but will crumble when touched.



*Colloids included in clay fraction in test reports.
**The LL and PI. of "Silt" plot below the "A" line on the plasticity chart, Table 4 and the LL and PI. for "Clay" plot above the "A" line.

Fig. 1. Soil separate size limits of ASTM, AASHO, USDA, CAA, Corps of Engineers and USBR.

Copied from Portland Cement Assn. Soil Primer



LAKE ST. LOUIS, Cont. Const.
Profile of Centerline of
Dam and Location and
Depth of Test Borings

Chart 2-9

Job No 157

Date 2-21-63

Sheet ___ of ___

Rig No ___ Casing used ___

Surface Elev ___ SS Size ___ Wt of Hammer ___

BORING NO. ___ FOR ___ WEATHER ___ TEMP. Cool

Sample No	Depth From	Depth To	Ivan Elevation	To Elevation	Distance Feet	Method	Penetration Record: Hydraulic Psi	Time Interval Sec	Number of Blows	Length Recovered Feet	SAMPLE DESCRIPTION Color – Moisture – Material – Consistency
	0.0	2.0			2.0	A					Topsoil, dry, brown, loose
	2.0	3.0			1.0	A					Clay, silty, dry, light brown, stiff
	3.0	5.0			2.0	A					Clay, silty, dry, light brown, stiff
	5.0	7.0			2.0	A					Clay, silty, dry, light brown, stiff
	7.0	9.0			2.0	A					Clay, silty, dry, light brown, stiff
	9.0	10.0			1.0	A					" " " " "
	10.0	12.0			2.0	A					Clay, silty, dry, light brown, stiff
	12.0	13.0			1.0	A					Clay, silty, dry, light brown, stiff
	13.0	15.0			2.0	A					Clay, silty, dry, light brown, stiff
											Boring terminated at 15.0 feet
	15.0	17.0			2.0	A					Clay, silty, dry, light brown, stiff
	17.0	17.5			0.5	A					" " " " "
	17.5	19.5			2.0	A					Clay, silty, dry, light brown, stiff

Chart 2-10

ABBREVIATIONS

F.T.-Fish Tail
W.O.-Wash Out
S.T.-Shelby Tube
S.S.-Split Spoon
D.B.-Diamond Bit
C. -Core
R.B.-Rock Bit
A. -Auger

Water Level _____ at _____ Hrs.

Job No 1--

Rig No _____

Casing used _____

Date 6-21-5-

Surface Elev _____

SS Size _____ Wt of Hammer _____

Sheet _____ of _____

BORING NO 1 Cont'd, FORE St. Levis Investigation Corporation

WEATHER Clear | TEMP 90s!

ABBREVIATIONS

F.T.-Fish Tail
W.O.-Wash Out
S.T.-Shelby Tube
S.S.-Split Spoon
D.B.-Diamond Bit
C. -Core
R.B.-Rock Bit
A. -Auger

Site: Dam site
Lake St. Louis
Route 94
O'Fallon, Missouri

Sample No.	Depth From	Depth To	From Elevation	To Elevation	Distance Feet	Method	Penetration Record: Hydraulic Pressure Psi	Penetration Record: Time Interval Sec	Penetration Record: Number of Blows	Length Recovered Feet	SAMPLE DESCRIPTION Color – Moisture – Material – Consistency
	10.2	10.4			2.1	AB					Limestone, gray,
	10.4	13.2			2.8	AB					Limestone, gray,
	13.2	20.2			7.0	AB					Limestone, gray,
	20.2	20.2			0.0	AB					Void - lost circulation, drilled 5 ft.
	20.2	23.2			3.0	AB					Lost circulation
											Description
											Rock above from 10.2 ft. to 20.2 ft.
											Loss of circulation at 20.2 ft.
											Void at 20.2 ft. to 23.2 ft.
											Limestone, gray, fossiliferous, medium
											grained, massive,
											in thin beds, fractured, fair recovery
											Horizontal cracks.
											Cored 3.0 ft. recovered 3.0 ft. other
											0.0 ft. was void.

Chart 2-11

Water Le[illegible] Hrs

Job No [illegible]

Rig No _____ Casing used _____

Date [illegible]

Surface Elev _____ SS Size _____ Wt of Hammer _____

Sheet: _____ of _____

BORING NO 3 FOR [illegible]

WEATHER [illegible] TEMP [illegible]

Sample No.	Depth From	Depth To	From Elevation	To Elevation	Distance Feet	Method	Penetration Record: Hydraulic Pressure Psi	Time Interval Sec	Number of Blows	Length Recovered Feet	SAMPLE DESCRIPTION Color – Moisture – Material – Consistency
	1	2.5			[illegible]						Brown-silty [illegible]
	2.5	3.0			[illegible]						Rubble
	5.0	7.0			[illegible]						Brown-cherty silty clay [illegible]
	7.0	[illegible]			[illegible]						Brown-cherty silty [illegible]
	[illegible]	[illegible]			[illegible]						Augered [illegible]
	[illegible]	11.8			[illegible]						Limestone and [illegible]

ABBREVIATIONS

F.T.-Fish Tail
W.O.-Wash Out
S.T.-Shelby Tube
S.S.-Split Spoon
D.B.-Diamond Bit
C -Core
R.B.-Rock Bit
A. -Auger

Site: Dam site
Lake St. Louis
Route #2
O'Fallon, Missouri

Chart 2-12

Water Level ____ at ____ hrs

Rig No ____ Casing used ____ Date ____

Surface Elev. ____ SS Size ____ Wt of Hammer ____ Sheet ____ of ____

BORING NO. ____ FOR Lake St. Louis ____ WEATHER Clear, TEMP. Cool

Sample No.	Depth From	Depth To	From Elevation	To Elevation	Distance Feet	Method	Penetration Record: Hydraulic Pressure Psi	Time Interval Sec	Number of Blows	Length Recovered Feet	SAMPLE DESCRIPTION Color – Moisture – Material – Consistency
											Site: 237 site Lake St. Louis Route 40 O'Fallon, Missouri
											Set 10' of 4" I.D. casing at ground level, and
											pressure maintained as [illegible], casing [illegible]
											[illegible] to wash out, [illegible]
											was set on to prevent water from [illegible]
											[illegible] core.
											Recovered 1.5 ft. of [illegible]
											[illegible]
											Cuttings from the tank were [illegible]
											Penetration [illegible]
											Cored 5.5' ft., recovered 1.5' ft.

ABBREVIATIONS

F.T.-Fish Tail
W.O.-Wash Out
S.T.-Shelby Tube
S.S.-Split Spoon
D.D.-Diamond Bit
C. -Core
R.B.-Rock Bit
A. -Auger

Chart 712

Water Level ____ at ____ hrs

Rig No. ____ Casing used ____

Surface Elev ____ SS Size ____ Wt of Hammer ____

Job No ____

Date ____

Sheet ____ of ____

BORING NO ? FOR [illegible]

WEATHER Cloudy | TEMP. Cool

Site: Par-site
Lake St. Louis
Route 40
O'Fallon, Missouri

Sample No	Depth From	Depth To	From Elevation	To Elevation	Distance Feet	Method	Penetration Record: Hydraulic Pressure Psi	Time Interval Sec	Number of blows	Length Recovered Feet	SAMPLE DESCRIPTION Color – Moisture – Material – Consistency
	0	[illegible]			[illegible]	1					[illegible]
	[illegible]	[illegible]			0.[illegible]	4					brown-shorty silty clay [illegible]
	[illegible]	[illegible]			1.[illegible]	4					[illegible] silty clay-[illegible] stiff
	[illegible]	[illegible]			2.[illegible]	1					brown-shorty clay-[illegible]
	[illegible]	[illegible]			1.[illegible]	1					[illegible]
	[illegible]	[illegible]			1.[illegible]	4					[illegible]
	[illegible]	[illegible]			[illegible]	1					[illegible]
	[illegible]	[illegible]			[illegible]	1					[illegible]
	[illegible]	[illegible]			[illegible]	6					[illegible]
											Limestone fragments, due to grey, coarse
											crystalline [illegible], containing [illegible]
											[illegible]
											[illegible]
											[illegible]
											[illegible]
											[illegible]
											[illegible]
											horizontal cutting planes between layers of
											limestone up to 1 in. in thickness.
											Cored 2.0 ft. and recovered 2.0 ft.

Chart 2-14

Water Level ____ at ____ Hrs

Job No. 157 ..

Rig No ____

Casing used ____

Date 9-25-59

Surface Elev. ____

SS Size ____ Wt of Hammer ____

Sheet ____ of ____

BORING NO. 4 FOR Lake St. Louis Investment Corporation

WEATHER Clear TEMP. Cool

ABBREVIATIONS

F.T.-Fish Tail
W.O.-Wash Out
S.T.-Shelby Tube
S.S-Split Spoon
D.B.-Diamond Bit
C. -Core
R.B.-Rock Bit
A. -Auger

Site: Dam site
Lake St. Louis
Route 40
O'Fallon, Missouri

Sample No.	Depth From	Depth To	From Elevation	To Elevation	Distance Feet	Method	Penetration Record: Hydraulic Pressure Psi	Penetration Record: Time Interval Sec	Penetration Record: Number of Blows	Penetration Record: Length Recovered Feet	SAMPLE DESCRIPTION Color – Moisture – Material – Consistency
	2.0	2.1			2.1	A					Brn-silty lean-rocky-dry-stiff
	2.1	2.8			2.7	A					Chert-limestone-small amount of charty clay directly above
	"										
	2.8	5.7			1.6	A					Brown-charty-silty clay-moist-medium
	5.7	7.7			-	-					Auger refusal

Chart 2-15

B & P PRINTING & OFFICE SUPPLY

Water Level _____ at _____ Hrs.

Rig No. C-[illegible]

Casing used _____

Surface Elev _____

SS Size _____ Wt of Hammer _____

Job No 157

Date 9-26-55

Sheet _____ of _____

BORING NO. 5 FOR Lake St. Louis Investment Corporation

WEATHER Cloudy | TEMP. Cool

Site: Dam site
Lake St. Louis
Route #2
O'Fallon, Missouri

Sample No.	Depth From	Depth To	From Elevation	To Elevation	Penetration Record: Distance Feet	Method	Hydraulic Pressure Psi	Time Interval Sec	Number of Blows	Length Recovered Feet	SAMPLE DESCRIPTION Color – Moisture – Material – Consistency
	0	2.0			2.0	1					Brown-silty loam clay- medium
	2.0	4.0			2.0	1					Brown-cherty silty clay-moist-medium
	4.0	5.5			1.5	4					Reddish-cherty clay-moist-medium
	5.5	6.5			1.0	4					Brownish-cherty clay-moist-medium
	6.5	10.0			3.5	4					Reddish brown-cherty clayey lot-moist
	10.0	10.5			0.5	23					Limestone and shale weathered color
	10.5	12.5			2.0	0					Description:
											Bedrock Formation is [illegible] crystalline [illegible] of chert. Several [illegible] between layers from ½" in. to 4 inches in thickness. Portions of core appeared somewhat weathered.
											Cored 2.4 ft. and recovered 2.4 ft.

ABBREVIATIONS

F.T.-Fish Tail
B.O.-Wash Out
S.T.-Shelby Tube
S.S.-Split Spoon
D.B.-Diamond Bit
C. -Core
R.B.-Rock Bit
A. -Auger

Chart 2-16

D & B DRILLING & OIL FIELD SUPPLY

FULTON, MISSOURI 65251
(314) MI 2-3777

Rig No. 24F

Water Level _____ at _____ Hrs

Casing used _____

SS Size _____ Wt of Hammer _____

Job No 157

Date 9-27-56

Surface Elev _____

Sheet _____ of _____

BORING NO 1 FOR Lake St. Louis Investment Corporation

WEATHER Cloudy TEMP. Cool

ABBREVIATIONS

F.T.-Fish Tail
W.O.-Wash Out
S.T.-Shelby Tube
S.S.-Split Spoon
D.B.-Diamond Bit
C. -Core
R.B.-Rock Bit
A. -Auger

Site: Dam site
Lake St. Louis
Route 22
O'Fallon, Missouri

Sample No.	Depth From	Depth To	From Elevation	To Elevation	Distance Feet	Method	Penetration Record: Hydraulic Pressure Psi	Time Interval Sec	Number of Blows	Length Recovered Feet	SAMPLE DESCRIPTION Color – Moisture – Material – Consistency
	0	2.0			2.0	A					Brown-silty loam-dry-medium
	2.0	5.0			3.0	A					Brown-silty clay- dry-medium
	5.0	5.5			1.5	A					Brown-sandy silty clay-moist-medium
	7.5	10.5			3.0	A					Medium brown- sandy clay-moist-stiff
	10.5	15.5			5.0	A					" " " " "
	15.5	18.0			2.5	A					" " " " " Ls
	18.0	18.5			–	–					Refusal

Quartz 2.17

B & B PRINTING & OFFICE SUPPLY

Water Level _____ at _____ Hrs

Job No. 127

Rig No 2-5

Casing used _____

Date 5-27-64

Surface Elev. _____

SS Size _____ Wt of Hammer _____

Sheet _____ of _____

BORING NO. 7 FOR Lake St. Louis [illegible] Corporation

WEATHER Cloud TEMP. Cool

Site: Dam site
Lake St. Louis
Route #2
Cirvilion, Missouri

Sample No.	Depth From	Depth To	From Elevation	To Elevation	Distance Feet	Method	Penetration Record: Hydraulic Pressure Psi	Penetration Record: Time Interval Sec	Penetration Record: Number of Blows	Penetration Record: Length Recovered Feet	SAMPLE DESCRIPTION Color – Moisture – Material – Consistency
	0.0	1.0			1.0	A					Brown-silt loam-dry-medium
	1.0	2.0			1.0	ST					Brown-silt loam-dry-medium
	2.0	3.0			2.0	A					Brown-sherty-silty clay loam-moist-medium
	3.0	3.5			0.5	ST					" " " " " " "
	3.5	4.0			0.5	ST					Brown-sherty-silty clay loam-moist-medium
	4.0	4.5			0.5	A					Brown-sherty-silty clay loam-moist-medium
	4.5	5.0			0.5	ST					Brown-sherty-silty clay loam-moist-medium
	5.0	6.0			1.0	A					Brown-sherty-silty clay loam-moist-medium
	6.0	7.0			1.0	ST					" " " "
	7.0	8.0			1.0	A					Brown-sherty-silty clay loam-moist-medium
	8.0	11.5			3.5	A					Brown-sherty-silty clay loam-moist-medium
	11.5	11.5			–	–					Auger refusal

ABBREVIATIONS

F.T.-Fish Tail
W.O.-Wash Out
S T.-Shelby Tube
S.S-Split Spoon
D.B.-Diamond Bit
C. -Core
R.B.-Rock Bit
A. -Auger

Chart 2-18

FOLEIC [illegible] 65251
(314) WI 2-5713

Water Level _____ at _____ Hrs

Job No. 157

Rig No. _____

Casing used _____

Date 2-27-65

Surface Elev _____

SS Size _____ Wt of Hammer _____

Sheet _____ of _____

BORING NO 5 FOR Lake St. Louis Investment Corporation

WEATHER Clear TEMP. Cool

Site: Borrow area below dam
Lake St. Louis
Route #2
O'Fallon, Missouri

ABBREVIATIONS
F.T.-Fish Tail
W.C.-Wash Out
S.T.-Shelby Tube
S.S.-Split Spoon
D.B.-Diamond Bit
C. -Core
R.B.-Rock Bit
A. -Auger

Sample No.	Depth From	Depth To	From Elevation	To Elevation	Distance Feet	Method	Penetration Record: Hydraulic Pressure Psi	Time Interval Sec	Number of Blows	Length Recovered Feet	SAMPLE DESCRIPTION Color – Moisture – Material – Consistency
	0	3.5			3.5	A					Brown-silt loam-dry-medium to stiff
	3.5	7.0			3.5	A					Brown-rocky-gravelly-dry-stiff
	7.0	9.0			2.0	A					Brown-rocky-cherty-silty clay-dry-medium to stiff
	9.0	10.0			1.0	A					Brown-rocky-cherty-clay-moist-stiff
	10.0	10.7			0.7	A					Brown-cherty-clay-moist-medium
	10.7	10.7			–	–					Auger refusal

Chart 2-19

Water Level ____ at ____ Hrs.

Job No 157

Rig No ____

Casing used ____

Date 2-27-75

Surface Elev ____

SS Size ____ Wt of Hammer ____

Sheet ____ of ____

BORING NO ____ FOR Lake St. Louis Investment Corporation | WEATHER Cloudy | TEMP. Cool

Site: Borrow area below dam
Lake St. Louis
Route 112
O'Fallon, Missouri

ABBREVIATIONS
F.T.-Fish Tail
W.O.-Wash Out
S.T.-Shelby Tube
S.S.-Split Spoon
D.B.-Diamond Bit
C. -Core
R.B.-Rock Bit
A. -Auger

Sample No.	Depth From	Depth To	From Elevation	To Elevation	Distance Feet	Method	Penetration Record: Hydraulic Pressure Psi	Penetration Record: Time Interval Sec	Penetration Record: Number of Blows	Penetration Record: Length Recovered Feet	SAMPLE DESCRIPTION Color – Moisture – Material – Consistency
	2	3.0			3.0	A					brown- silt loam-dry-medium
	3.0	10.0			7.0	A					brown-silt loam-dry-medium
	"										
	10.0	12.0			2.0	A					brown-cherty silty clay-dry-medium
	12.0	17.			5.0	A					brown-cherty clay-soft-medium to [illegible]
	17.0	17.2			0.2	A					limestone-Yeadon formation
	17.2	17.4			"	"					auger refusal

Chart 2-20

Water Level ___ at ___ Hrs.

Job No 157

Date 9-27-65

Casing used ___

SS Size ___ Wt of Hammer ___

Sheet ___ of ___

BORING NO. 10 FOR Lake St. Louis Investment Corporation

WEATHER Cloudy TEMP Cool

Site: Borrow area below dam
Lake St. Louis
Route #2
O'Fallon, Missouri

Sample No.	Depth From	Depth To	From Elevation	To Elevation	Distance Feet	Method	Penetration Record: Hydraulic Pressure Psi	Time Interval Sec	Number of Blows	Length Recovered Feet	SAMPLE DESCRIPTION Color – Moisture – Material – Consistency
	0	2.3			2.3	A					Brown-silt loam-dry-medium
	2.3	5.4			3.1	A					brown-rocky-silt loam-dry-stiff
	5.4	9.0			3.6	A					brown-rocky-silt loam-moist-medium
	9.0	12.0			3.0	A					Brown-shorty clay-moist-medium
	12.0	17.0			5.0	A					brown-shorty rocky clay-stiff
	17.0	17.5			0.5	A					Penetration into limestone
	17.5	17.5			-	-					Auger refusal

ABBREVIATIONS

F.T.-Fish Tail
W.O.-Wash Out
S.T.-Shelby Tube
S.S.-Split Spoon
D.B.-Diamond Bit
C -Core
R.B.-Rock Bit
A. -Auger

CHART 2-11

Rig No 2

Surface Elev.

Casing

SS Size Wt. of Hammer

Job No

Date

Sheet ____ of ____

BORING NO. FOR

WEATHER TEMP. Cool

Site: St. Louis
Route #2
O'Fallon, Missouri

Sample No.	Depth From	Depth To	From Elevation	To Elevation	Distance Feet	Method	Penetration Record: Hydraulic Pressure Psi	Time Interval Sec	Number of Blows	Length Recovered Feet	SAMPLE DESCRIPTION Color – Moisture – Material – Consistency
	[illegible]	1.[illegible]			1.[illegible]	[illegible]					[illegible] silty clay [illegible]
	[illegible]	[illegible]			[illegible]						[illegible] boulder
	[illegible]	[illegible]			[illegible]						[illegible]ish brown [illegible] clay [illegible]
	[illegible]	[illegible]			[illegible]	3					[illegible]
	[illegible]	[illegible]			–	[illegible]					[illegible]
	[illegible]	[illegible]			–	[illegible]					[illegible] Formation, tan to gray [illegible]
											[illegible] crystalline, with thin [illegible]
											[illegible]

ABBREVIATIONS
P.T. - Fish Tail
W.O. - Wash Out
S.T. Shelby Tube
S.S. Split Spoon
D.B. - Diamond Bit
C. - Core
R.B. - Rock Bit
A. - Auger

Chart 2-22

D & D PRINTING & OFFICE SUPPLY

FULTON, MISSOURI 65251
(314) MI 2-5719

Water Level ___ at ___ Hrs

Job No. 157

Rig No ___

Casing used ___

Date ___

Surface Elev. ___

SS Size ___ Wt of Hammer ___

Sheet ___ of ___

BORING NO. 12 FOR Lake St. Louis [illegible] Corporation

WEATHER Cloudy TEMP. Cool

Site: Borrow area below dam
Lake St. Louis
Route 40
O'Fallon, Missouri

ABBREVIATIONS
F.T.-Fish Tail
W.O.-Wash Out
S.T.-Shelby Tube
S.S.-Split Spoon
D.B.-Diamond Bit
C. -Core
R.B.-Rock Bit
A. -Auger

Sample No.	Depth From	Depth To	From Elevation	To Elevation	Distance Feet	Method	Penetration Record: Hydraulic Pressure Psi	Time Interval Sec	Number of Blows	Length Recovered Feet	SAMPLE DESCRIPTION Color – Moisture – Material – Consistency
	0.0	10.0			10.	A					Brown-gray lean to silty clay-trace silt
	10.0	15.0			5.	A					Brown-cherty silt clay-trace-silica
	15.0	20.0			5.	A					Brown-cherty silty clay-gravel to sand
	20.0	22.0			2.	A					Auger refusal

Chart 2-23

[illegible] TESTING LABORATORIES, INC.
Route 2 Hwy 54 North
FULTON, MISSOURI 65251
(314) MI 2-5719

P & D PRINTING & OFFICE SUPPLY

Water Level _____ at _____ Hrs.

Job No. 157

Rig No. CME

Casing used _____

Date 9-20-63

Surface Elev. _____

SS Size _____ Wt of Hammer _____

Sheet _____ of _____

BORING NO. 17 FOR Lake St. Louis Investment corporation | WEATHER cloudy | TEMP. cool

Site: Borrow area above dam
Lake St. Louis
Route 42
O'Fallon, Missouri

Sample No.	Depth From	Depth To	From Elevation	To Elevation	Distance Feet	Method	Penetration Record: Hydraulic Pressure Psi	Time Interval Sec	Number of Blows	Length Recovered Feet	SAMPLE DESCRIPTION Color – Moisture – Material – Consistency
	0	7.7			7.7	3					Red-sherty clay-moist-stiff
	7.7	7.7				-					Auger refusal
	"										

ABBREVIATIONS

F.T.-Fish Tail
W.O.-Wash Out
S.T.-Shelby Tube
S.S.-Split Spoon
D.B.-Diamond Bit
C -Core
R.B.-Rock Bit
A. -Auger

Chart 2-14

B & B PRINTING & OFFICE SUPPLY

BORING TESTING LABORATORIES, INC.
Route 2, Hwy. 54 North
FULTON, MISSOURI 65251
(314) MI 2-5719

Water Level _____ at _____ Hrs.

Job No. 157

Rig No. CME

Casing used _____

Date 9-29-66

Surface Elev _____

SS Size _____ Wt of Hammer _____

Sheet _____ of _____

BORING NO [illegible] FOR Lake St. Louis Investment Corporation

WEATHER Cloudy TEMP. Cool

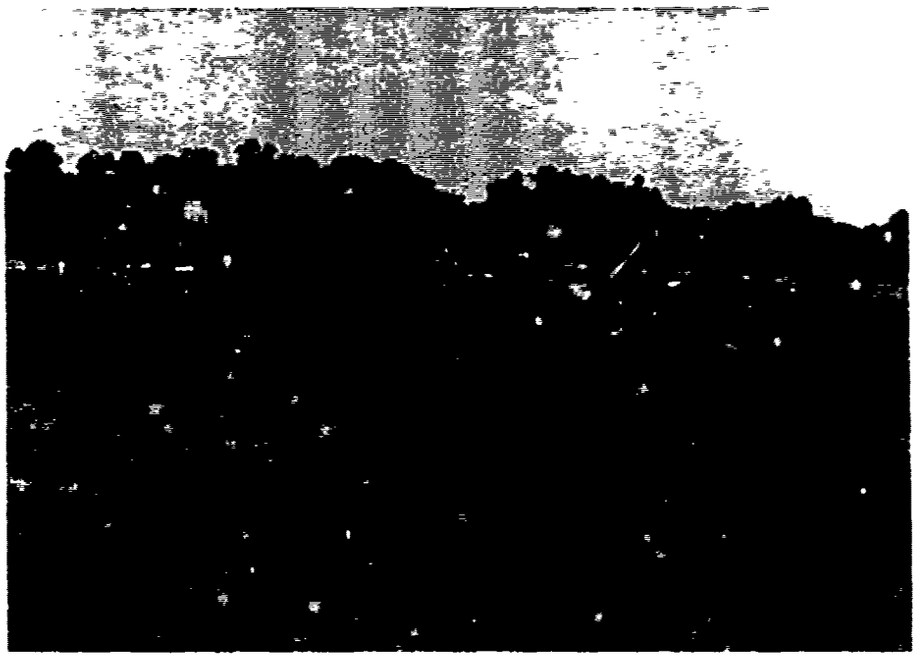
Site: Corner area - across dam
Lake St. Louis Rt. "K"
O'Fallon, Missouri

Sample No.	Depth From	Depth To	From Elevation	To Elevation	Distance Feet	Method	Penetration Record: Hydraulic Pressure Psi	Time Interval Sec	Number of Blows	Length Recovered Feet	SAMPLE DESCRIPTION: Color -- Moisture -- Material -- Consistency
	0	2.5			2.5	A					Partial pavement, clayey to silty
	2.5	7.0			4.5	A					[illegible] clayey to silty
	7.0	7.0			-	-					[illegible]

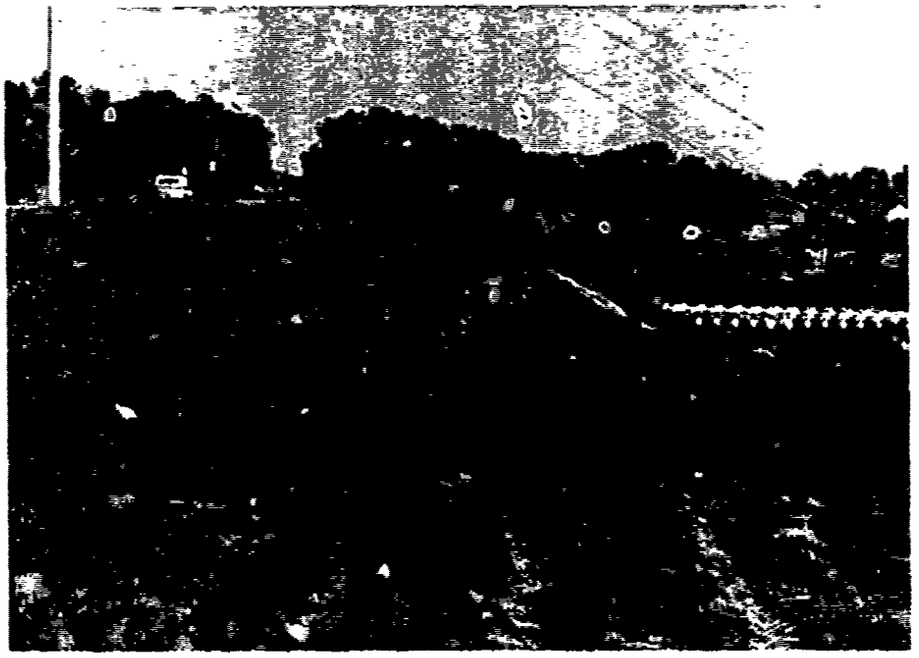
ABBREVIATIONS
F.T.-Fish Tail
W.O.-Wash Out
S.T.-Shelby Tube
S.S.-Split Spoon
D.B.-Diamond Bit
C -Core
R.B.-Rock Bit
A. -Auger

Chart 2-25

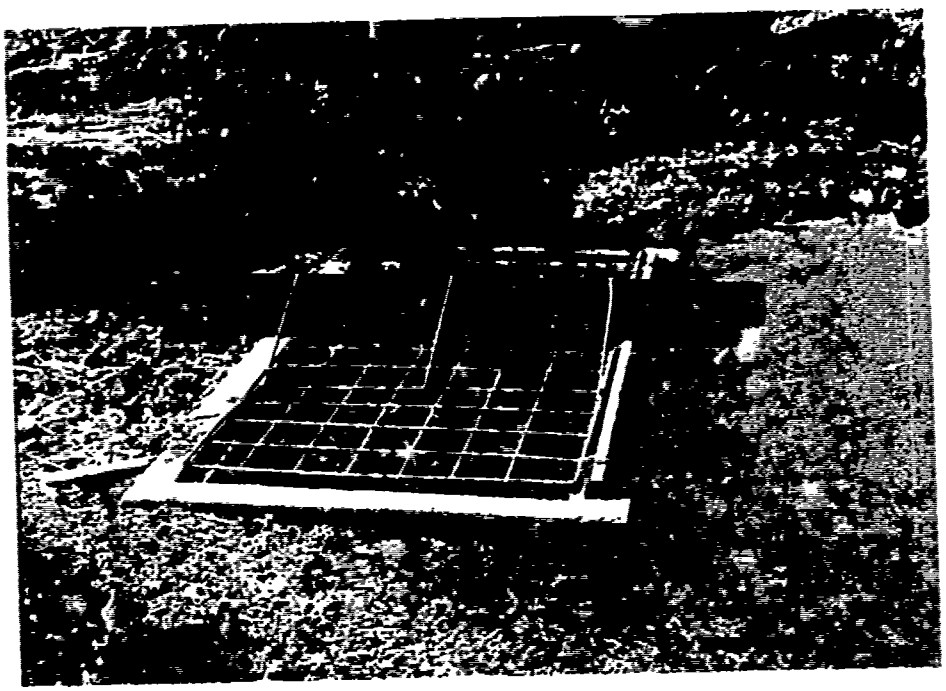
APPENDIX



NO. 1: UPSTREAM FACE OF DAM



NO. 2: DOWNSTREAM FACE OF DAM

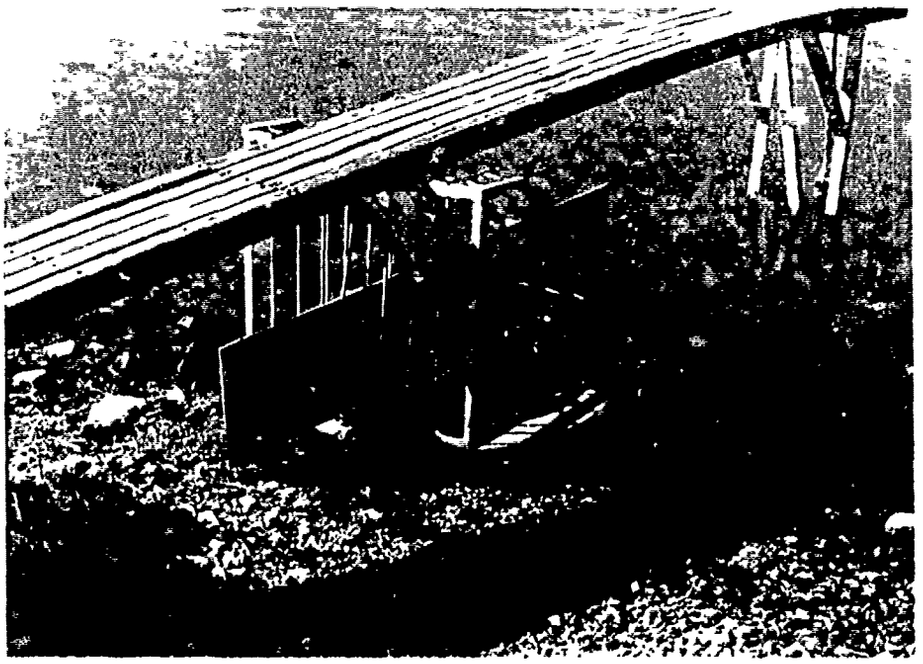


NO. 3: 48"x102" DROP INLET SPILLWAY

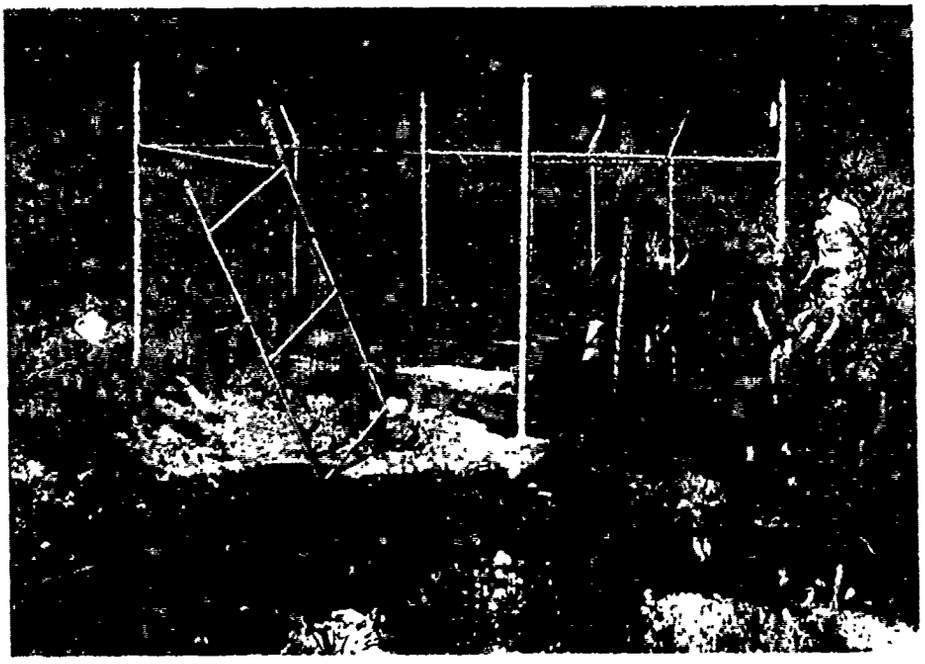
NO. 4: MANHOLE AT END OF 36" OUTLET PIPE

NO. 5: OUTLET DITCH DOWNSTREAM OF MANHOLE

NO. 6: OUTLET DITCH NEAR LAKE SAINT LOUIS



No. 7: 42" DIAMETER DROP INLET SPILLWAY

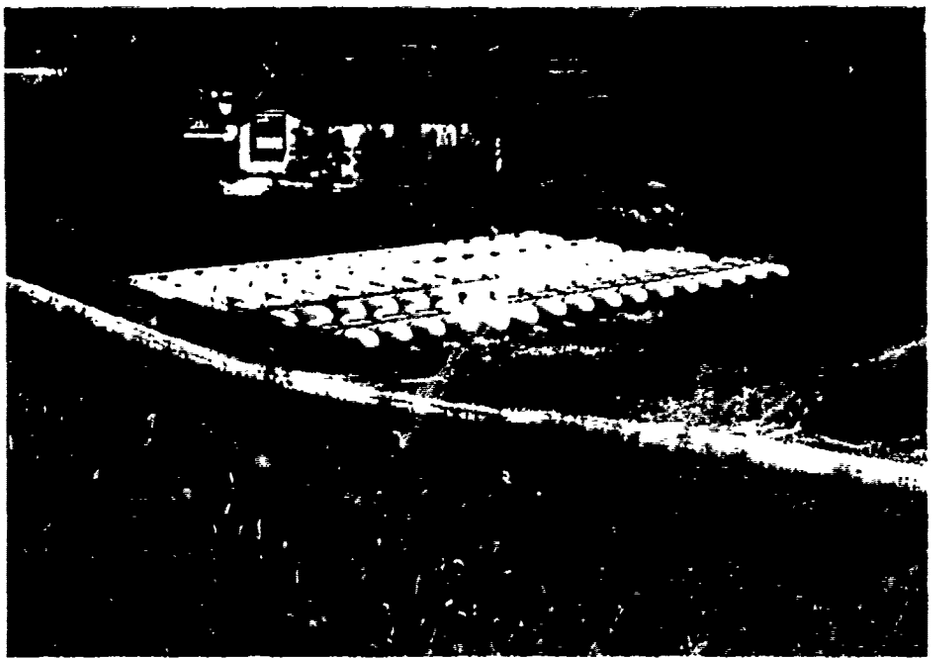


NO. 8: PUMP BASE

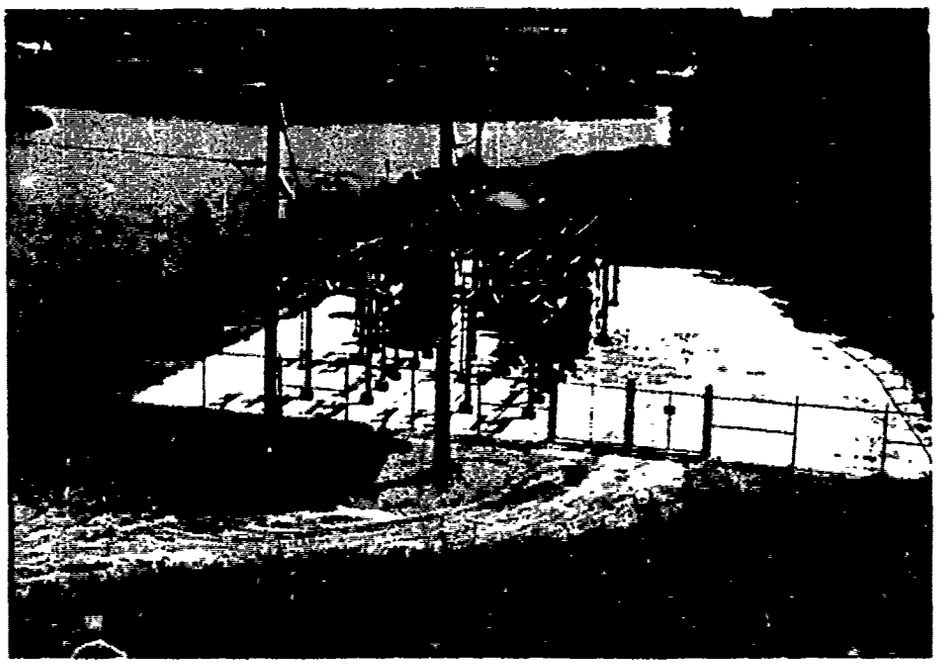
NO. 9: 10" VALVE ON PUMP DISCHARGE LINE

NO. 10: PONDED WATER ON BERM

No. 11: EROSION FROM DISCHARGE OF
12" OUTLET PIPE



NO. 12: LP TANK FARM



NO. 13: ELECTRIC SUBSTATION

HYDROLOGIC COMPUTATIONS

1. The HEC-1 Dam Safety Version (July 1978) program was used to develop inflow and outflow hydrographs and dam overtopping analyses, with hydrologic inputs as follows:

a. Probable maximum precipitation (200 sq. mile, 24-hour value equals 25.0 inches) from Hydrometeorological Report No. 33. One hundred year frequency (one square mile precipitation, 24-hour value equals 7.22 inches) from U.S. Weather Bureau Technical Paper No. 40.

b. Drainage area = 1.04 square miles
= 664 acres

c. SCS parameters
Lag time = 0.39 hours
Soil Type CN = 95

2. Drop inlet spillway release rates were based on the broad-crested weir equation and limited, where applicable, by the capacity of their respective outlet pipes.

$Q = CLH^{\frac{3}{2}}$ (C = 3.0 for drop inlet spillways, L = 25 feet for 48" x 102" spillway, L = 11 feet for 42" diameter spillway), where H is the head on the weir crest.

3. The emergency spillway section and dam crest consist of broad-crested, approximately V-shaped sections for which conventional weir formulas do not apply.

Release rates were determined as follows:

(1) Crest section properties (area, a and top width, t) were computed for various depths, d.

(2) It was assumed that flow leaving the crest would occur at critical depth. Flow at critical depth (Q_c) was computed as $Q_c = (\frac{a^3}{t}\ g)^{0.5}$ for the various depth, d.

Corresponding velocities (v_c) and velocity heads (H_{vc}) were determined using conventional formulas.

(3) Static lake levels corresponding to the various Q_c values passing over the crest were computed as critical depths plus critical velocity head ($d_c + H_{vc}$), and the relationship between lake level and crest discharge was thus obtained. The procedure neglects the minor insignificant friction losses across the length of the crest.

4. The combined outflow rating curve for flow over the drop inlet spillways and the emergency spillway and dam crest was obtained by adding corresponding discharges for given elevations. This rating curve is shown on Plate 4. Inflow-outflow hydrographs for the PMF are shown on Plate 5.

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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  3 AUG 78
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    1                 A1       ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
    2                 A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF LAKE STE LOUISE DAM
    3                 A3       RATIOS OF PMF ROUTED THROUGH RESERVOIR
    4                 R     288         0         5        -0        -0        -0        -0        -0        -0        -0
    5                 B1      5
    6                 J       1         3         1
    7                 J1   0.22      0.50      1.00
    8                 K       0   INFLOW
    9                 K1       INFLOW HYDROGRAPH                                                  3         1
   10                 M       1         2      1.04
   11                 P       0      25.0       102       120       130      1.0                                    1
   12                 T
   13                 W2                0.39                                                                -1       -95
   14                 X    -1.0      -.10       2.0
   15                 K       1       DAM                                                 2         3         1
   16                 K1       RESERVOIR ROUTING BY MODIFIED PULS
   17                 Y                                                    1         1
   18                 Y1      1                                                                    1170        -1
   19                 Y4  545.3     545.8    546.35     547.3     547.6     547.8       548     548.3     548.6       549
   20                 Y4  549.3     549.5     549.8       550     550.2     550.4
   21                 Y5      0        35        90        90       130       190       310       640      1100      1930
   22                 Y5   2860      3660      5100      6200      7500      8900
   23                 $A      0        72        91       140
   24                 $F496.55     545.3       550       560
   25                 $$  545.3
   26                 $D  548.3
   27                 K      99
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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  3 AUG 79
**********
    1                 A1       ANALYSIS OF DAM OVERTOPPING USING 100 YR FLOOD
    2                 A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF LAKE STE LOUISE DAM
    3                 A3       100 YR FLOOD ROUTED THROUGH RESERVOIR
    4                 R    288        0        5      -0       -0       -0       -0       -0       -0       -0
    5                 R1     5
    6                 J      1        1        1
    7                 J1   1.0
    8                 K      0   INFLOW                                  3        1
    9                 K1       INFLOW HYDROGRAPH
   10                 V      0        2     1.04                     1.0                         1
   11                 C    288
   12                 01  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
   13                 01  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
   14                 01  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
   15                 01  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
   16                 01  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
   17                 01  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
   18                 01  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
   19                 01  .007     .007     .014     .014     .014     .014     .014     .014     .014     .014
   20                 01  .014     .014     .014     .014     .014     .014     .014     .014     .014     .014
   21                 01  .014     .014     .014     .014     .014     .014     .014     .014     .014     .014
   22                 01  .014     .014     .014     .014     .014     .014     .014     .014     .022     .022
   23                 01  .022     .022     .022     .022     .022     .022     .022     .022     .022     .022
   24                 01  .022     .022     .022     .022     .022     .022     .031     .031     .031     .031
   25                 01  .031     .031     .061     .061     .061     .061     .061     .061     .132     .132
   26                 01  .133     .251     .251     .550     .823     .382     .251     .133     .132     .132
   27                 01  .061     .061     .061     .061     .061     .061     .031     .031     .031     .031
   28                 01  .031     .031     .022     .022     .022     .022     .022     .022     .022     .022
   29                 01  .022     .022     .022     .022     .022     .022     .022     .022     .022     .022
   30                 01  .014     .014     .014     .014     .014     .014     .014     .014     .014     .014
   31                 01  .014     .014     .014     .014     .014     .014     .014     .014     .014     .014
   32                 01  .014     .014     .014     .014     .014     .014     .014     .014     .014     .014
   33                 01  .014     .014     .014     .014     .014     .014     .007     .007     .007     .007
   34                 01  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
   35                 01  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
   36                 01  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
   37                 01  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
   38                 01  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
   39                 01  .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
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39   O1   .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
40   O1   .007    .007    .007    .007    .007    .007    .007    .007
41   T                                                      -1      -95
42   W2           0.39
43   X    -1.0    -.10    2.0
44   K      1     DAM                     2       3       1
45   K1         RESERVOIR ROUTING BY MODIFIED PULS
46   Y                                    1       1
47   Y1     1                                                1170    -1
48   Y4  545.3    545.8   546.35  547.3   547.6   547.8    548     548.3   548.6   549
49   Y4  549.3    549.5   549.8   550     550.2   550.4
50   Y5     0      35      90      90      130     190      310     640     1100    1930

51   Y5  2860     3660    5100    6200    7500    8900
52   SA     0      72      91      140
53   SE496.55    545.3   550     560
54   $$ 545.3
55   SD 548.3
56   K     99
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